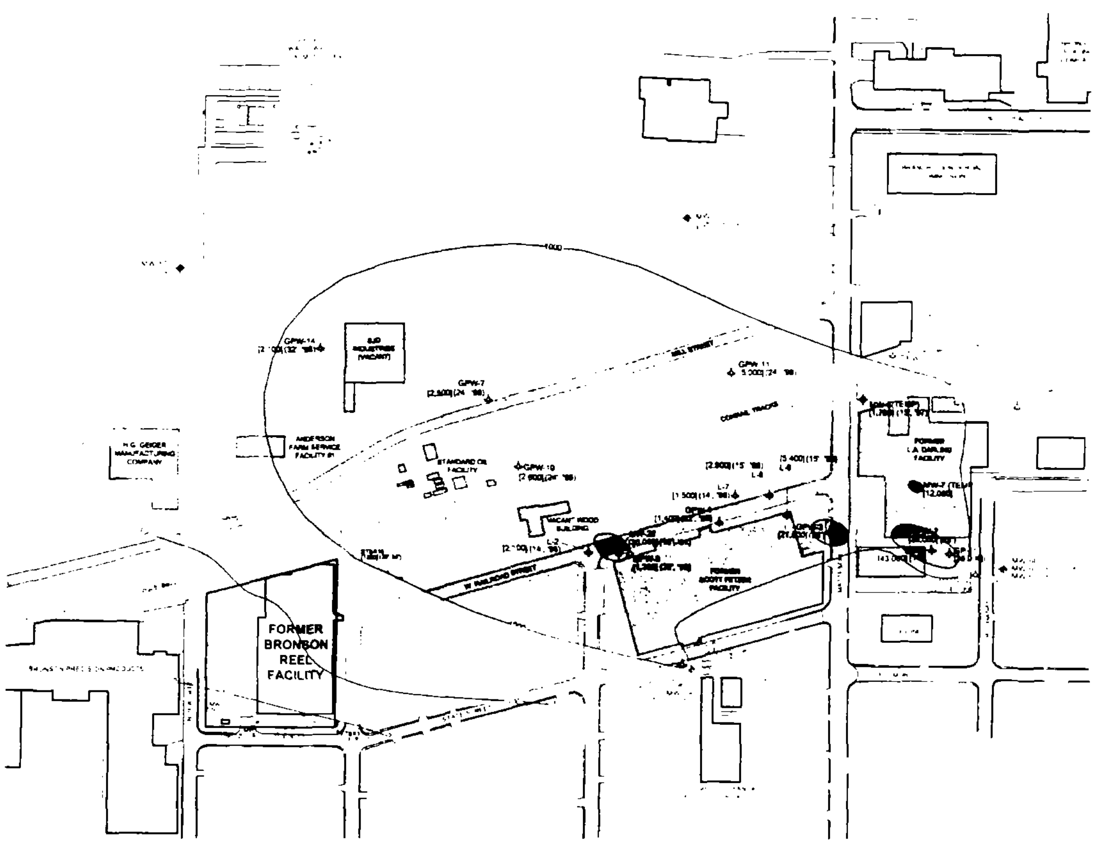
Streamlined Remedial Investigation/ Streamlined Risk Assessment Report



Former Bronson Reel Facility - NBFF OU1
Bronson, Michigan

June 2, 2005

STREAMLINED REMEDIAL INVESTIGATION/ STREAMLINED RISK ASSESSMENT REPORT

North Bronson Former Facilities
Former Bronson Reel Facility – NBFF OU1
Bronson, Michigan

EPA SITE IDENTIFICATION NUMBER A4E7

Prepared for:

ITT Industries, Inc.
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In association with:
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June 2, 2005

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North Bronson Former Facilities
Former Bronson Reel Facility – NBFF OU1
Bronson, Michigan

The undersigned certify that they have reviewed the attached document and that the document is in material compliance with the requirements of the Administrative Order on Consent and Scope of Work dated September 30, 2002 for the North Bronson Former Facilities, Bronson Reel facility – Operable Unit I (NBFF OU1). To the best of our knowledge, this report is also in material compliance with applicable state and federal regulations. The data presentations contained herein are consistent with Fletcher Driscoll & Associates and Earth Tech standards and generally accepted practices in the environmental profession.

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LIST OF ACRONYMS

°F	Degrees Fahrenheit
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethylene
1,1,1-TCA	1,1,1-Trichloroethane
1,2-DCE	1,2-Dichloroethylene
ADQR	Analytical Data Quality Report
amsl	Above Mean Sea Level
AOC	Administrative Order by Consent
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
CD	Consent Decree
CD30	County Drain Number 30
Cis-1,2-DCE	Cis-1,2-Dichloroethylene
COC	Compound of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DO	Dissolved Oxygen
DOT	Department of Transportation
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
DRO	Diesel Range Organics
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level
ESV	Ecological Screening Value
ETS	Endangered, Threatened, and Special Concern
FDA	Fletcher Driscoll & Associates, LLC
FFS	Focused Feasibility Study
g/mL	Grams per Milliliter
GPR	Ground Penetrating Radar
GRO	Gasoline Range Organics
GWCS	Groundwater Collection System
HHRA	Human Health Risk Assessment
Higbie	Higbie Manufacturing Company
HQ	Hazard Quotient
IDW	Investigation Derived Waste
ITT	ITT Industries, Inc.
Kuhlman/New BSI	Kuhlman Corporation / (New) Bronson Specialties, Inc.
LNAPL	Liquid Non-aqueous Phase Liquid
MCL	Maximum Contaminant Level
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MNFI	Michigan Natural Features Inventory
mg/kg	Milligrams per Kilogram
NAD	North American Datum
NAVD	North American Vertical Datum
NBFF	North Bronson Former Facilities

LIST OF ACRONYMS (Continued)

NBIA	North Bronson Industrial Area Superfund Site
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
OU	Operable Unit
OVA	Organic Vapor Analyzer
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PID	Photo Ionization Detector
ppm	Parts per Million
PRE	Preliminary Risk Evaluation
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RI	Remedial Investigation
ROD	Record of Decision
SMDP	Scientific/Management Decision Point
SOW	Scope of Work
SRA	Streamlined Risk Assessment
SRI	Streamlined Remedial Investigation
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCE	Trichloroethylene
TPH	Total Petroleum Hydrocarbon
Trans-1,2-DCE	Trans-1,2-Dichloroethylene
UST	Underground Storage Tank
VOC	Volatile Organic Compound
μg/kg	Micrograms per Kilogram
μg/L	Micrograms per Liter

EXECUTIVE SUMMARY

The findings and recommendations of this Streamlined Remedial Investigation/Streamlined Risk Assessment (SRI/SRA) conclude that Site-related compounds of concern (COCs), with the possible exception of total petroleum hydrocarbons (TPH), exist at such low concentrations that no groundwater plume originates at the Site. The risk assessment indicates that Site-related COCs do not pose an unacceptable potential risk to human health, the environment, or ecological receptors provided that the property continues to be zoned for industrial use. Therefore, a Focused Feasibility Study (FFS) should be prepared which evaluates a no further action remedy and the institutional controls that may be necessary for ongoing protection of human health and the environment. Any concerns regarding residual TPH at the facility should be addressed separately with the current property owner under Michigan's Part 201, M.C.L. 324.20101 *et seq.*, outside of the Superfund process.

The conclusions of the SRI/SRA for the former Bronson Reel facility are as follows:

1. Remedial work completed by Kuhlman Corporation/Bronson Specialties Inc. from 1989 to 1990 included the removal of 70 percent of the exposed Site soils, generally down to the water table. The purpose of these excavations was to remove oil-stained soils and soils with metal concentrations above background levels.
2. Prior to excavation, soils at six boring locations were screened using an organic vapor analyzer (OVA), and on the basis of the screening four samples were selected for VOC analysis. TCE was not detected in any of these samples.
3. Following the excavation, forty-one soil samples were collected from the excavation sidewalls and from borings installed outside of the excavation. Of these forty-one samples, TCE was detected at low concentrations (60 micrograms per kilogram (µg/kg) and 110 µg/kg) in only two samples.[1]
4. There is no indication that degreasers were used in Bronson Reel operations based on available historic operational information.
5. The maximum concentration of TCE detected in on-site soils during this SRI (conducted in 2003 and 2004) is 2.6 µg/kg.
6. TCE is not detected in oil or groundwater collected from MW2 in the vicinity of the former chip bins.
7. Extensive investigation of the Site and areas near the Site during the SRI has demonstrated TCE concentrations detected in groundwater beneath the Site are part of a regional groundwater plume migrating beneath the Site from a source or sources located to the east.
8. The areal distribution of TCE and TCE degradation products at and near the Site indicates that the dominant groundwater flow direction is to the west-northwest toward County Drain Number 30 (CD30), although flow is sometimes to the west or southwest when the water table is low.

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[1] For comparison, the current Michigan Soil Cleanup Criteria that is protective of residential drinking water is 100 µg/kg.

9. Completion of the SRA using conservative risk-based screening values for industrial land use and subsequent weight-of-evidence analyses shows that site-related contaminants pose no unacceptable potential risk to human health or the environment.

1.0 INTRODUCTION

The North Bronson Industrial Area (NBIA) is a federal Superfund site located in the City of Bronson, Michigan that encompasses an area of 220 acres (Figure 1-1). It is bounded on the north by an engineered drainage canal known as CD30, on the east by Lincoln Street as projected northward to CD30, on the south by Fillmore and Union Streets, and on the west by Burr Oak Road as projected northward to CD30.

In the early 1900s, metal-plating operations at various facilities in the North Bronson area discharged wastewater directly to CD30. Cattle and fish kills in the 1930s were linked to ingestion of cyanide-contaminated water from this drain. In response to concerns about water quality in CD30, the City of Bronson built and operated the western lagoons in 1938. Bronson Reel, Scott Fetzer, and LA Darling discharged plating wastes to the western lagoons through an industrial sewer built by the City. Later, responding to overuse of the western lagoons, the City constructed new lagoons in 1949 on the east side of the NBIA. Three companies—LA Darling, Bronson Plating, and Scott Fetzer—discharged wastewater to the eastern lagoons via the eastern industrial sewer. Bronson Reel did not discharge to the eastern lagoons.

Along with LA Darling, Bronson Plating, Scott Fetzer, and the City of Bronson, ITT Industries, Inc. (ITT) was listed as a potentially responsible party (PRP) for the NBIA Superfund Site - Operable Unit No. 1 (OU1) consisting generally of the western and eastern lagoons, CD30, and groundwater use restrictions by ordinance throughout the 220-acre NBIA. On June 23, 1998, EPA issued a Special Notice letter to ITT for NBIA OU1. ITT was named a PRP because of its 1972 acquisition of a former Bronson Reel facility owner, Higbie Manufacturing (Higbie) (which had sold the Bronson Reel Company and the facility 9 years earlier). Although ITT has only a remote connection with this former facility, ITT is a cooperating party and has responded to U.S. Environmental Protection Agency (EPA) Special Notice letters. In March 1999, the NBIA PRP Group signed a Consent Decree (CD) to implement the Record of Decision (ROD) for NBIA OU1. ITT was a signatory to that CD, which was filed on February 29, 2000. Since that time ITT has been a member in good standing with the NBIA OU1 PRP Group.

1.1 North Bronson Former Facilities

On September 29, 2000, the EPA issued a Special Notice Letter to the PRPs, including ITT, to begin negotiations with the EPA to conduct a Baseline Risk Assessment and Feasibility Study for the western industrial sewer (NBIA OU2). Negotiations for this work were difficult because of a lack of information concerning potential source areas at individual facilities located upgradient of the industrial sewer. EPA and the PRPs agreed to terminate negotiations regarding the NBIA OU2 and proceed with investigations at the North Bronson Former Facilities (NBFF). The former Bronson Reel facility is designated NBFF OU1; the other facilities include the former LA Darling facility (NBFF OU2), and the former Scott Fetzer facility (NBFF OU3). The locations of these former facilities are shown on Figure 1-2.

1.2 NBFF OU1 Streamlined Remedial Investigation and Risk Assessment

In July 2001, ITT received a Special Notice letter from the EPA for the former Bronson Reel facility. The AOC and Statement of Work (SOW) requiring ITT to complete a SRI/SRA and a Focused Feasibility Study (FFS) were signed by EPA on September 30, 2002. This SRI/SRA Report was prepared on behalf of ITT in accordance with the requirements of the AOC and SOW for the NBFF OU1 (EPA, 2002b).

The objectives stated in the AOC follow:

a) *To determine the nature and extent of TCE contamination in groundwater caused by the release or threatened release, if any, of TCE from [NBFF] OU1 (excluding the industrial sewer) by conducting a remedial investigation;*

b) *To determine and evaluate alternatives for remedial action (if any) to prevent, mitigate or otherwise respond to or remedy identified risks from [NBFF] OU1-related contamination other than that determined to be caused by the industrial sewer or other off-Site sources; and*

c) *To provide for the recovery of response and oversight costs incurred by the EPA with respect to the Consent Order.*

Thus, the primary goal for the SRI is to determine the nature and extent of TCE contamination in groundwater at the former Bronson Reel facility (Site), and whether any such TCE contamination was caused by a release or threatened release from the Site. In addition, the SRA must determine whether there are any unacceptable risks from the Site that are not caused by the industrial sewer or off-Site sources.

1.3 Site Description and Background

The former Bronson Reel facility is located at 505 North Douglas Street in the City of Bronson, which is in south-central Michigan. The City of Bronson sits on a glacial outwash plain with little topographic relief at an elevation approximately 910 to 920 feet above mean sea level (amsl). An area of slightly higher elevation caused by the presence of low ridges composed of glacial till is located northwest of the City; a marshland lies just to the northeast (Figure 1-1). The marshland drains to Swan Creek, which flows north of Bronson and eventually turns to the southwest. An engineered drainage canal known as CD30 flows along the northern boundary of the City of Bronson and the NBIA and eventually discharges to Swan Creek (Figure 1-1).

1.3.1 Population

The population of the City of Bronson is approximately 2,367 according to the most recent estimate by the U.S. Census Bureau. Bronson is located in Branch County which comprises 507 square miles with an estimated population of 45,414 (an average of 90.2 persons per square mile). There is no metropolitan area within Branch County.

1.3.2 Meteorology/Climatology

The continental climate in the Bronson area is characterized by large seasonal temperature ranges (Michigan State Climatologist's Office, 2004). The Coldwater

School Station, located approximately 13 miles east of Bronson, is the closest long-term weather observation station. According to records for this station, the mean monthly temperatures range from 21.6 degrees Fahrenheit (°F) in January to 70.7 °F in July with a mean annual temperature of 47.2 °F (National Oceanic and Atmospheric Administration [NOAA], 2004). Average annual precipitation calculated from NOAA records from 1931 through 2003 is 34.6 inches. The months from April through September are the wettest months, with the highest precipitation typically in August (3.94 inches). Long periods of below-average precipitation occurred from 1933 to 1946 when annual precipitation was below average for 12 of the 14 years and from 1962 through 1964 when precipitation was well below average (27-inch deficit over 3 years) (Figure 1-3). Since 1996, precipitation has been above average except for 2002.

1.3.3 Former Bronson Reel Facility Ownership and Operational History

The Site was developed by the Bronson Reel Company[2] in 1929 for the manufacture of fishing reels. Operations included metal plating and machining of small parts used to make fishing reels and other precision components. Beginning in the middle 1950s, Bronson Reel began to anodize its reels, thereby reducing the extent of its plating processes. In 1963, Higbie sold its Bronson Reel Division, including the Site, to (Old) Bronson Specialties, Inc. Following the sale, the production of fishing reels declined and finally terminated in 1968. After 1968, production of machine screws and other metal parts were continued by (Old) Bronson Specialties, Inc. Plating operations were discontinued in 1969, and the plating lines were sold in mid 1970. Machining of small metal parts was continued by (Old) Bronson Specialties, Inc. until 1979, by Kuhlman Corporation/(New) Bronson Specialties, Inc. (Kuhlman/New BSI) from 1979 through 1984 and, finally, by Bronson Precision Products, Inc. from 1984 until at least the early 1990s. ITT has only a remote connection to the Site based on a merger between a subsidiary of ITT and Higbie in 1972. Because this merger occurred nine years after Higbie sold the Bronson Reel Division and the Site to Bronson Specialties, Inc., ITT never controlled Higbie when Higbie/Bronson Reel operated the Site.

The former reel-manufacturing facility occupies 1.85 acres and includes a 43,500 square-foot former manufacturing building and one 2,600 square-foot outlying building formerly used for storage (Figure 1-4; Site photographs are included in Appendix A). Manufacturing processes included two nickel plating lines, one chromium plating line, and two cadmium barrel plating lines. Cyanide was used in the cadmium plating lines; however, the cadmium barrel lines were reportedly only used on a seasonal basis (approximately 10 percent of the time). The use of anodizing processes, beginning in the 1950s, reduced the use of cyanide.

There are no operational or environmental data indicating that VOCs were used as part of the regular manufacturing process at the Bronson Reel Company. In other words, there is no knowledge or evidence of degreasers, degreasing pits or tanks, or use of significant quantities of TCE or other solvents for any purpose at the former Bronson Reel Site.

After 1968, Bronson Specialties, Inc. and subsequent operating entities continued the production of machine screws and other metal parts. Metal shavings and cuttings were stored outside in uncovered bins located in the southwestern corner of the main yard area.

[2] Bronson Reel Company was a wholly-owned subsidiary of McAleer Manufacturing Company which changed its name to Higbie Manufacturing Company in 1950.

After 1985, Bronson Precision Products operations reportedly consisted of a screw machine, casting machines, and a metal turning shop. Chemicals used at the Site included cutting oils, lubricating oils, naphtha, water soluble oils, and synthetic oils. Small quantities, less than 5 gallons per month, of 1,1,1-trichoroethane (1,1,1-TCA) were reportedly used by Bronson Precision Products (former employee interview, Chuck Hawkins and Cecil Davis, Bronson Precision Products, included in Appendix A of the NBIA Remedial Investigation [RI], [Warzyn, 1993]).

Currently, no manufacturing operations are conducted on-Site, and the facility is vacant; however, the property owner, BorgWarner Corporation/(New) Bronson Specialties Inc. has indicated that the facility is being leased and will be used to store construction equipment in the future. The Site is fenced and secured to prevent potential trespassing. Electrical power and water are not currently in service at the facility.

1.3.4 Surrounding Land Use

The former Bronson Reel facility is bounded on the north by a railroad that is currently owned by the Branch and St. Joseph Counties Rail Users Association. An industrial area occupied by the H.G. Geiger Manufacturing Company and Anderson Farm Service Facility #1 exists north of the now inactive railroad. The Bronson Wastewater Treatment Plant is located north of the Anderson Farm Service facility. The area north and west of the H.G. Geiger Manufacturing Company is agricultural. Properties immediately east of the Site are residential; the former LA Darling and Scott Fetzer sites lie farther east along West Railroad Street. Bronson Plating is located to the north of the former LA Darling facility. Residential properties exist south and southeast of the Site. Bronson Precision Products/Royal Oak Industries has an active manufacturing business immediately west of the Site (Figure 1-2). Previously, a Standard Oil facility was located approximately 200 feet northeast of the former Bronson Reel Site from at least 1927 through 1955.

1.3.5 Past and Current Groundwater Use in Site Area

The City of Bronson relies on groundwater for its public water supply. According to the NBIA RI, in 1993 the City of Bronson system consisted of three wells (Warzyn, 1993). Two primary supply wells (Wells No. 4 and No. 5) are located approximately 4,000 to 5,000 feet east of the NBIA and are screened in the upper aquifer. A backup well (No. 3) was located approximately 1,000 feet southeast of the eastern lagoons; it is screened in the lower aquifer.[3] No contaminants were ever found in Well No. 3, but because of its proximity to the NBIA and its low yield, the well was taken out of service by the City in the late 1980s and abandoned by 1993 according to a Michigan Department of Public Health correspondence dated 1996 (Appendix B).

The only known industrial well in the NBIA is located at Bronson Plating, approximately 2,000 feet northeast of the Site. This well is completed in the lower aquifer and is used to supply process water.

Five private residential wells in the city were identified for sampling purposes during the NBIA RI (Warzyn, 1993). Additional residential wells have been identified and sampled at various times by the Michigan Department of Public Health. Only a few wells are located in the vicinity of the former Bronson Reel facility (Figure 1-5). Boring logs are

[3] An areally extensive till aquitard separates the lower aquifer from the shallow unconfined aquifer.

not available for any of these wells. Analytical results for sampling conducted by the Michigan Department of Public Health, if available, are provided in Appendix B. The well located at 422 Mill Street, approximately 450 feet west-northwest of the Site, appears to have been abandoned in the past decade. Seven wells 500 to 750 feet southwest of the Site may still be active; available information on these wells is summarized below.

- 422 Mill Street - Low concentrations of 1,2-dichloroethylene (1,2-DCE) were detected in groundwater from this well in 1996 and 1997.[4] A February 1998 MDEQ Interoffice Communication reported that this well was abandoned and the property connected to the municipal water supply.
- 322 Franklin Street – No volatile organic compounds (VOCs) were detected when this well was sampled in 1995. Recent City of Bronson billing records indicate that this property is connected to the municipal water system. It is not known whether this well has been abandoned.
- 417 Franklin Street – This well was last sampled by the Health Department in September 2003. No VOCs were detected in the 2003 sample or in any samples collected back to 1989. It appears that this well may still be in use.
- 418 Franklin Street – This well was sampled in July 1995 by the Health Department. No VOCs were detected in the sample. It is not known whether or not this well is still in use.
- 426 Franklin Street – This well, which was built around 1953, is a 2-inch drive point set at a depth of 30 feet. No VOCs were detected in the well in 1995 or 1998. Billing records indicate that this well may still be in use. It is not known whether the well has been sampled since 1998.
- 406 and 418 Shaffmaster Blvd. – The property owner at 406 Shaffmaster Blvd. indicates that the well is a 1.25" drive point set at a depth of approximately 45 feet and was constructed in about 1950. The well was sampled by the Health Department in September 2003. No VOCs were detected in this sample or any samples dating back to July 1993. City of Bronson billing records indicate that the property at 406 Shaffmaster Blvd. is not connected to the municipal water system. The City's billing records also indicate that an adjacent property at 418 Shaffmaster Blvd., owned by the same person, is not connected to municipal water. This property may also be supplied by the documented well at 406 Shaffmaster Blvd.
- 425 Shaffmaster Blvd. – No VOCs were detected in a sample collected from this well in 1995. Based on city billing records, this well may still be in use.
- 429 Shaffmaster Blvd. – No VOCs were detected in a sample collected from this well in 1995. Based on city billing records, this well may still be in use.
- 425 Union Street – City of Bronson sewer and water billings indicate that this address is billed only for sewer and not water. The well was sampled most

[4] Cis-1,2-DCE and trans-1,2-dichloroethylene (trans-1,2-DCE) were not detected in samples collected in January 1989. Cis-1,2-DCE was first detected in samples collected in January 1996 at a concentration of 1.3µg/L. Trans-1,2-DCE was first detected at a trace concentration in samples collected in February 1996. Cis- and trans-1,2-DCE were detected at concentrations of 5.4 µg/L and 0.7 µg/L, respectively, in March 1997.

recently by the Health Department in September 2003. No VOCs were detected in the sample.

With the exception of the well at 422 Mill Street, which has been abandoned, the wells listed above have been sampled at various times from 1989 through 2003, and no VOCs have been detected in those samples.

As a part of compliance with the NBIA OU1 ROD and CD, the NBIA OU1 PRP Group has proposed a groundwater ordinance that would restrict the use and construction of shallow wells within the boundaries of the NBIA (restricted zone) and establish a buffer zone located south and east of the restricted zone (Figure 1-5). Use of the private wells described above, with the possible exception of the 417 Franklin Street well, would be prohibited under the proposed ordinance. The proposed groundwater ordinance was submitted to the MDEQ for review on February 27, 2004. The NBIA PRP Group has contracted with its consultant to locate and document all existing wells in the restricted and buffer zones of the city ordinance. The resulting technical memorandum will supplement the information provided above regarding existing wells in the NBIA. Proper abandonment of these wells and connection to city water has been proposed and if approved, will be completed at the expense of the NBIA OU1 PRP group. The City of Bronson has agreed to implement the proposed ordinance when the form and language of the ordinance is approved by MDEQ.

1.3.6 Sensitive Ecosystems

The Site offers limited and low quality terrestrial habitat (see Site photographs in Appendix A). The natural vegetative cover has long been disturbed by industrial activities. The Site is currently overgrown with early successional herbaceous and woody vegetation that has colonized the Site since its abandonment. The closest water bodies are the western lagoons and CD30, both of which are man-made features located more than 1,000 feet north of the Site (Figure 1-2). Because of the lack of preferred habitat, endangered and threatened species are highly unlikely to occur at the Site. For a more complete discussion of the Site ecology, please refer to Section 7.4.

1.4 Previous Site Investigations and Remedial Actions

On June 14, 1988, the Michigan Health Department[5] inspected the Site, which at that time was operated by Bronson Precision Products under lease from Kuhlman/New BSI. Shortly thereafter, the Health Department issued a list of required corrective actions based on the results of the Site inspection that included proper containment of waste storage drums and metal shavings and removal of soils contaminated with cutting oils (Michigan Department of Public Health, 1988). Thereafter, the Site owner at the time, Kuhlman/New BSI conducted an investigation and subsequent removal action in 1988 through 1990. Excavation of soils proceeded in several phases resulting in the removal of 10,440 tons of soil. In fact, 70 percent of the exposed soils within the facility's fence has been removed, down to the water table in most areas. These excavations also included removal of an underground oil storage tank, an oil-water separator, and a portion of the NBIA industrial sewer along the northern edge of the property. These removal actions are also summarized in the Site Status Report, Former Bronson Reel

[5] Personnel from a local office (Branch, Hillsdale, St. Joseph District Health Department) performed the inspection and wrote the follow-up correspondence.

Facility, prepared by Fletcher Driscoll & Associates, LLC (FDA) dated March 2001 (FDA, 2001).

1.4.1 Soil Excavations

Soil excavation occurred in several phases from the fall of 1988 through the winter of 1989. The excavations were conducted to remove oil-stained soils and soils with metal concentrations above background levels. Soil boring results indicate that metal concentrations decreased rapidly with depth and generally were below background concentrations at depths greater than 5 feet below ground surface (bgs) (Tables 1-1 and 1-2). Over most of the main yard area, however, soils were removed down to the water table (a depth of 8 to 10 feet bgs) because either the soils were stained with oil or organic vapor analyzer (OVA) measurements indicated hydrocarbons were above background levels. Soil analytical results for TPH, aromatic hydrocarbons, and semi-volatile organic compounds (SVOCs) are presented in Tables 1-3, 1-4 and 1-5, respectively. The analytical summary tables also include samples that were collected from the sidewalls of each excavation prior to backfilling. It is important to note that initial sampling and analysis before excavation did not indicate the presence of VOCs.

1.4.2 Removal of Underground Storage Tanks

An 8,000-gallon underground storage tank (UST) that originally held #2 fuel oil and, later, cutting oils, was removed from the northeast corner of the main yard area during the first phase of the excavation in August and September 1988 (Figure 1-6). Oil-saturated soils were removed down to the water table in the vicinity of the tank.

A second UST, believed to be an oil-water separator, was found during excavation of the central part of the yard area in the spring of 1989 (Figure 1-6). Water and oil remaining in the tank were removed, and the tank was excavated. In this area, oil-stained soils were encountered to a depth of about 5 feet bgs, but excavation continued because OVA readings were consistently positive down to the water table. An oil sheen was observed on the groundwater at the base of the excavation. Prior to backfilling the excavated yard area, a groundwater/free product collection system (GWCS) consisting of a vertical, perforated concrete pipe connected to four, 8-inch steel groundwater collection pipes was installed at the approximate location of the former oil-water separator to collect any residual oils that might accumulate on the water table. It is unknown whether the GWCS was monitored subsequent to backfilling of the excavation by the Site owner (Kuhlman/New BSI) and, if so, whether any free product was removed.[6]

1.4.3 Industrial Sewer Excavation and Removal

During excavation at the north end of the property in the fall of 1989, a buried pipe running south to north along the western edge of the main building was encountered (Figure 1-6). At its northern end, the pipe was connected to an east-west trending pipe extending from beneath the main building to the northwest corner of the property where it turned north and continued under the railroad tracks. Although the NBIA location maps indicate the industrial sewer is located north of the former Bronson Reel property, careful review of the 1977 video inspection report (prepared for Scott Fetzer) and distances recorded on the city sewer maps indicate that this east-west oriented pipe found within

[6] No free product was observed in the GWCS during the SRI field activities.

the property boundaries is, in fact, the city's western industrial sewer (Appendix A in Warzyn, 1993). The south-north pipe appears to have been a connection pipe from the facility to the western industrial sewer.

During the soils excavation, a portion of the industrial sewer pipe was broken, releasing approximately 500 gallons of liquid that was described as mostly water and some sediment. At the time of the break, the industrial sewer had not been used for approximately nine years, and over 20 years had elapsed since it had conveyed plating wastes. The soils surrounding the rupture were excavated and placed into a watertight waste container. Sediment samples were collected from the industrial sewer at the point where it was ruptured and from catch basins associated with the piping. The south-north connection pipe and the portion of the industrial sewer between the main building and the northwest corner of the property were excavated and removed; at the main building, the industrial sewer was grouted with cement. Prior to backfilling the excavation, samples were collected from the sidewalls of each excavation. The results of the excavation wall samples are discussed below.

1.4.4 Early Hydrogeologic Investigation

From 1989 through 1990, a hydrogeologic investigation was performed at the Site by Kuhlman/New BSI including the installation of six shallow monitoring wells (MW1 through MW6) (Figure 1-7). All of the monitoring wells were constructed with 5-foot long, polyvinylchloride (PVC) screens placed to intercept the water table. Well construction logs are included in Appendix C. Based on the groundwater elevation measurements taken in 1989 and 1990, groundwater flow was to the northwest across the Site. One groundwater sample was collected from each of the monitoring wells except MW4;[7] two rounds of samples were collected from MW3. Each sample was analyzed for cadmium, chromium, copper, lead, nickel, zinc, and VOCs; three samples were analyzed for cyanide. The only compounds detected that exceeded the maximum containment level (MCL) for drinking water were chromium, detected at 120 µg/L in the first round of sampling from MW3 (the MCL is 100 µg/L for chromium), and TCE, detected in MW5 and MW6 at concentrations of 14 µg/L and 37 µg/L, respectively (the MCL for TCE is 5 µg/L). TCE was not detected in groundwater samples collected from MW1 and MW2, but was detected at levels below the MCL in MW3 (Fletcher Driscoll & Associates, 2001).

1.4.5 Effectiveness of Removal Actions

As described above, the removal actions focused on soils that contained metals above background levels or that exhibited oil staining or elevated OVA readings. Soil borings completed before the soil removal indicated that metals concentrations decreased rapidly with depth. Thus, the various excavations effectively removed metal concentrations that exceeded background levels. In accordance with the AOC/SOW, residual metals detected in excavation wall samples and in borings installed outside the excavated areas are included in the data set evaluated in the risk assessment section of this report (Section 7.0). Soils affected by cutting oils continued down to the water table in three areas: in the northeast portion of the yard, including beneath the 8,000-gallon underground storage tank; beneath the oil-water separator; and in the southwest yard area. An oil sheen was

[7] According to Site reports, monitoring well MW4 was intended to be a downgradient well. After groundwater flow measurements demonstrated the well was located side-gradient to the facility yard, it was not sampled.

observed on the groundwater at the base of the excavation in the southwestern portion of the yard. Free product was observed in 2003 and 2004 at MW2, which is located in the southwest corner of the yard area near the former location of the shavings/cutting bins (refer to Sections 2.7 and 5.3 for information regarding free product characterization).

VOCs were not the focus of these early removal actions because initial sampling and analysis did not indicate the presence of VOCs. A total of 45 soil samples were collected and analyzed for VOCs. The locations of these samples are shown in Figure 1-8, the compounds detected in these soils samples are shown in Table 1-6, soil boring logs are included in Appendix C, and laboratory results are included in Appendix D. A summary of the sampling results is provided below.

After excavation of the northeast corner of the main yard area in 1988, a representative of Westside Landfill visited the Site to obtain a sample from the excavated soils (sample BPP1). The sample was analyzed for typical plating metals, Michigan Department of Natural Resources (MDNR) scans for purgeable halocarbons and purgeable aromatic hydrocarbons, flash point and cyanide. No VOCs were detected in this sample. Chromium, copper, lead, nickel, and zinc were detected, but at concentrations below the current Michigan Soil Cleanup Criteria that are protective of residential drinking water (MDEQ, 2000).

Prior to excavation, six soil borings were installed on-Site in October 1988 to 10 feet bgs (locations B1, B3/4, B5, B6, B7, and B8). The soils were field screened for the presence of vapors with an OVA. At borings B1 and B7, no readings above background levels were measured on the OVA; as a result, no samples were analyzed for VOCs. At borings B3/4 and B5, OVA readings reached a maximum of 100 parts per million (ppm) at approximately 6 feet bgs, but readings dropped to 0 ppm at a depth of 10 feet bgs. No samples were analyzed for VOCs From locations B3/4 and B5. At boring B6, OVA readings ranged from 20 to 50 ppm down to 9 feet bgs. In sand layers at 9 feet and at the water table (9.6 to 10 feet bgs), the readings ranged from 300 to 500 ppm. Consequently, a soil sample was obtained at the 10-foot depth to be analyzed for VOCs. Trans-1,2 DCE was detected in this sample at 81 micrograms per kilogram (μg/kg), well below the current Michigan Soil Cleanup Criteria of 2,000 μg/kg which is protective of drinking water. TCE was not detected above the detection limit of 50 μg/kg. At boring B8, OVA readings ranged between 60 ppm at a depth of one foot to 100 ppm at 10 feet. Soil samples were obtained at 1-, 3-, and 10-foot depths to be analyzed for VOCs. No VOCs were detected in any of the samples.

The elevated OVA readings noted above were most likely caused by the presence of hydrocarbons which were known to exist in the yard area. Analysis of the soils that had the highest OVA readings (up to 500 ppm) show that VOCs (solvents) were not present above detection limits in these samples (with the exception of one detection of 81 μg/kg of trans-1,2-DCE). Ethylbenzene and toluene (volatile compounds that are present in hydrocarbons) were present in all four of the boring samples, however, at concentrations up to 440 μg/kg. TPH was present in 50 of the 61 soil samples collected in 1988 to 1990 at concentrations up to 22,440 mg/kg (Table 1-3). TPH is the only group of compounds that have been found in Site soils at concentrations that could be detected in the ppm range by an OVA. During the recent SRI field work, up to 0.3 feet of oil was measured at MW2. Analysis of this oil, conducted during the recent SRI, indicated the presence of some lighter-end hydrocarbons (54,000 µg/kg of C_6 - C_{10})[8]. Fingerprint analysis concluded that the oil was generally comprised of higher-molecular weight hydrocarbons similar to motor oil, but that lighter fractions, similar in pattern to diesel oil, were also present. Cutting oils and fuel oil both have been stored and used at the facility. TPH from any source (cutting oils, fuel oil, etc.) is comprised of hundreds of non-halogenated compounds, such as alkanes, alkenes and additives that are not identified during analysis. Many of these compounds, however, can be detected by an OVA during field screening. Based on only one detection of a solvent (trans-1,2-DCE) at a low concentration (81 µg/kg) in soil samples and the presence of TPH in over 80 percent of the soil samples at concentrations up to 22,440 mg/kg in site soils, the elevated OVA readings obtained before and during the excavation were the result of TPH in soils.

Soil samples were also collected from the sidewalls of each excavation. Only two samples had detections of TCE: $E(S)_{W2}$ at a concentration of 60 µg/kg and S_{W2} at a concentration of 110 µg/kg (Figure 1-8). These samples were collected from the east and south sidewalls of the excavation between the main building and the storage building. While there are no records of TCE use at the facility, the presence of low concentrations of TCE in these two isolated soil samples may indicate that some incidental use of the compound (or its presence as a component of another material) may have occurred at some time at the facility; however, the only evidence of this is the two low-level detections in these two sidewall samples. The current Michigan Soil Cleanup Criteria that is protective of residential drinking water is 100 µg/kg. Thus, the TCE concentration at S_{W2} slightly exceeded this criterion. Unfortunately, the depth of the samples was not recorded at the time of collection. No other samples from this area contained VOCs, including a sample collected within the southeast corner of the excavated area prior to excavation ($SE_{Corner\ 2}$).

Borings were installed outside of the fence line to the south (B9), southwest (B10), west (B11 and B12), and northwest (B2) of the Site. Soil samples were collected above the water table at 2-foot intervals. TCE was not detected in any of these samples. Similarly, soil samples were collected during the installation of monitoring wells MW1 through MW5. TCE was not detected in any of these samples.

1.4.6 Data Gaps

Geoprobe® samples collected by the MDEQ in 1998 and analyzed by MDEQ's mobile laboratory indicated that deeper groundwater was affected by TCE directly north of the Site (MDEQ, May 1999). Groundwater samples were collected by MDEQ at depths of 14 to 18, 22 to 26, 30 to 34, and 38 to 42 feet bgs from Geoprobe® locations GPW4, GPW5, GPW6, GPW9, and GPW12, located to the north and northwest of the former Bronson Reel facility (Figure 1-7 and Table 1-7). The highest TCE concentration (3,900 µg/L) was detected at 22 to 26 feet bgs in GPW4, located directly north of the facility and approximately 20 feet downgradient of the City's industrial sewer. The concentrations of TCE measured 150 feet to the east and west of GPW4 were 18 µg/L at GPW6 and 34 µg/L at GPW5, indicating that the concentrations detected at GPW4 declined rapidly to the east and west. Thus, based on GPW4, there was some suggestion that a TCE source might exist at the former Bronson Reel facility and that additional investigation was needed to determine if the Site was the source of this TCE. It was this single,

[8] The C# indicates the number of carbon molecules in the carbon chain.

anomalously high VOC data point at this location north of the Site that was the impetus for the comprehensive SRI/SRA groundwater investigation of the Site.

2.0 SRI ACTIVITIES AND METHODS

The purpose of this SRI is to determine whether or not there is a Site source for the TCE found in groundwater north of the Site at GPW4 in 1998 (MDEQ, 1999). Limited soil sampling was conducted during the SRI because almost all of the accessible Site soils had been removed during the previous excavations. Furthermore, dozens of soil samples were collected outside the excavated area during the earlier investigations and provide a substantial base of information. The SRI activities, therefore, focused on the collection of groundwater samples that were analyzed for the presence of metals and VOCs. Up to seven groundwater samples were collected at each of 23 locations on and near the facility. Continuous lithologic characterization was performed at each of the 23 locations, and groundwater was profiled vertically beginning at the water table and continuing to the till at the base of the aquifer. In addition, groundwater samples were collected at the existing Site monitoring wells that could be located and redeveloped. The resulting SRI data set, when used in conjunction with the historic soils data, now provides an extensive base of information that permits an evaluation of the 1998 data recorded at GPW4. The SRI activities are discussed in the following sections.

2.1 Development of Work Plan

The documents that comprise the final SRI/FFS Work Plan for NBFF OU1 are listed in Table 2-1. The documents reflect multiple expansions of the original scope of work that was initially approved by the EPA and referenced in the AOC and SOW documents. Following submittal of the draft SRI/FFS Work Plan, the field sampling program was increased from four sampling depths at seven locations to seven sampling depths at sixteen locations at the request of MDEQ and a new EPA project manager. Subsequently, the agencies requested a second phase of field work to collect additional samples in the north-central portion of the property. The Phase II sampling plan was also expanded by ITT to collect additional upgradient groundwater and background soils data. Finally, a third phase of field work was conducted to collect six soil samples to fill a minor data gap that was identified during the data analysis. All of the work plan documents were reviewed and approved by EPA and MDEQ personnel; all of the work conducted under this SRI/SRA was performed in accordance with the final SRI/FFS Work Plan as listed in Table 2-1. The resulting chemical data set provides a comprehensive understanding of the conditions at and in the vicinity of NBFF OU1.

2.2 Summary of Field Work

As mentioned above, the SRI field investigation activities were performed during three separate phases. Soil sample locations are shown on Figure 2-1; groundwater sample locations are shown on Figure 2-2. Sample depths and analyses for each location are summarized for soil and groundwater in Tables 2-2 and 2-3, respectively. Photographs of portions of the field work are included in Appendix A.

2.2.1 Phase I Activities

Phase I of the SRI field investigation was performed from July through October 2003. The main purpose of this phase of work was to determine whether or not a source of TCE exists on-Site. As a result, a number of Geoprobe® locations were clustered southeast of GPW4 in the north-central portion of the property. In addition, Geoprobes® were installed in the yard portion of the Site to establish groundwater quality beneath the area that had been excavated west of the main building. Samples also were collected east and south of the facility to define upgradient groundwater quality and northwest of the Site to define downgradient groundwater quality. The Phase I SRI activities included the following tasks:

- The condition of the existing monitoring wells was evaluated and, where appropriate, the wells were repaired, redeveloped, and resurveyed. Groundwater samples were collected from monitoring wells MW1, MW3, and MW4. A groundwater sample was not collected from MW2 because of the presence of TPH as light non-aqueous phase liquid (LNAPL). In spite of considerable effort, former monitoring wells MW5 and MW6 could not be located.
- Sixteen Geoprobe® sample locations (ETBR1 – ETBR16) were installed to the depth of the till aquitard underlying the surficial sand and gravel aquifer; continuous lithologic characterization was performed, and either six or seven groundwater samples were collected at each location depending on the depth of the till aquitard. The samples were analyzed for VOCs, TPH, metals, hexavalent chromium, and cyanide.
- Soil samples were collected at two locations (ETBR4 and ETBR5) and tested for VOCs.
- Three temporary piezometers were installed (ETPZ3, ETPZ13, and ETPZ16).
- The property boundaries and facility building corners were surveyed along with the location and elevation of the Geoprobe® borings, temporary piezometers, GWCS,[9] existing on-Site monitoring wells, and two NBIA monitoring wells.
- Water levels were measured at four existing Site monitoring wells, two NBIA monitoring wells, the GWCS, and the three temporary piezometers. LNAPL thickness was measured at MW2, and a LNAPL sample was collected and submitted for characterization.

2.2.2 Phase II Activities

Phase II of the SRI field investigation was performed during January and February 2004. The purpose was to establish current concentrations at the approximate location of GPW4 and install additional borings in the north-central portion of the property. These additional borings were requested to investigate groundwater conditions immediately upgradient of GPW4 on a finer sampling grid. A representative of MDEQ confirmed the original location of GPW4. In addition, three borings were installed east of the facility to define groundwater quality upgradient of the facility and establish soil background concentrations. The second phase of work included the following tasks:

[9] This GWCS is the free product/groundwater collection system that was installed during the 1989 excavation. Four radially oriented, perforated pipes installed at the base of the excavation enter the GWCS at an elevation that was approximately 1.5 feet above the water level in April 2003. Product was not present in the GWCS at anytime during the SRI. Groundwater quality samples, representative of conditions in the vicinity of the GWCS, were collected at nearby ETBR12.

- Seven Geoprobe® sample locations (ETBR17 through ETBR23) were installed to the depth of the till; continuous lithologic characterization was performed; either six or seven groundwater samples were collected at each location depending on the depth of the till; the samples were analyzed for VOCs, TPH, and metals.
- Soil samples were collected at four locations (ETBR17 and ETBR21 through ETBR23) and analyzed for VOCs; soils were also collected at three upgradient locations (ETBR18 through ETBR20) and analyzed for VOCs and metals.
- The location and elevation of the seven new Geoprobe®sample locations were surveyed.
- Groundwater elevations were measured on two occasions.
- The industrial and storm water sewers near the Site were examined and mapped by opening and examining manholes, smoke testing, and conducting remote video inspections.

2.2.3 Phase III Activities

Phase III of the SRI field investigation was performed during the week of June 28, 2004. Six soil samples were collected from three locations (ETBR24 through ETBR26) using a hand auger. The soils were analyzed for total and hexavalent chromium, as well as soil indicator parameters. These samples were collected to provide information about the concentration of hexavalent chromium in Site soils. The samples were collected at the approximate locations where the highest concentrations of total chromium were reported for historic soil samples. Groundwater elevations also were measured during this third phase of field work.

2.3 Soil Sampling Locations and Methodology

Continuous soil cores were collected from boring locations ETBR1 through ETBR23 to characterize the lithology of the surficial materials down to the top of the till aquitard. In general, the depth of each boring was approximately 50 feet. Soil descriptions, including moisture content, color, grain size, angularity, and other pertinent textural or mineralogical properties, were recorded on the Test Boring Report forms, which are included in Appendix E. Continuous lithologic data were collected to provide a detailed picture of the characteristics of the surficial materials and a conceptual understanding of the surface of the till. Unsaturated soil core samples were screened for the presence of volatile organics using a Photo Ionization Detector (PID); the readings are provided on the boring logs.

During Phase I field activities, soil samples were collected from four depths at ETBR4 and ETBR5 and tested for the presence of VOCs. These sample locations are near the storage building in the north-central part of the yard. ETBR4's location was selected by agency personnel to be as near as possible to the only two locations where TCE had been detected in historic soil samples and yet be installed in native soils. ETBR5 was located approximately 25 feet southeast of GPW4 where TCE had been reported in deeper groundwater by MDEQ in 1998. At the agencies' request, soil samples were collected for VOC analysis at an additional four borings installed in this same general area during the second phase of activities. ETBR17 was located north of the Site at the approximate location of GPW4. ETBR21 also was located off-Site approximately 40 feet east of

ETBR17. The boring at ETBR22 was installed through the floor of the small storage shed; ETBR23 was installed approximately 40 feet to the east of ETBR22. The purpose of these additional four borings was to establish whether or not there are current TCE concentrations in the vicinity of GPW4 and determine whether or not a potential TCE source exists at the Site, southeast of GPW4.

Background soil samples were collected east of the facility at ETBR18, ETBR19, and ETBR20. These samples, collected from three depth intervals, were analyzed for both VOCs and metals. The results were used to determine if, and at what concentration, constituents are present in background soils.

Six additional soil samples were collected and tested for both total and hexavalent chromium from two depth intervals at ETBR24, ETBR25, and ETBR26 in June 2004. These samples were collected to fill a minor data gap that was identified for hexavalent chromium soils data. The six soil samples were also analyzed for additional indicator parameters such as pH, iron, and sulfides/sulfates to define the soil conditions associated with the chromium samples.

2.4 Monitoring Well Rehabilitation

Existing monitoring wells were examined to determine if they were suitable for use during the SRI. Monitoring wells MW2 and MW4 did not require any structural repair work. MW1 had been completed with a flush-mount top that could not be opened. As a result, the concrete pad and protective well cap were replaced at MW1. The above-ground surficial well casing and protective casing had been damaged at MW3. To repair the well, the casing was cut below the damaged section, and a new section of well casing was coupled to the existing casing and secured with stainless steel screws. A new concrete pad and above-grade protective casing and cover were also installed at MW3.

Numerous attempts were made to locate preexisting monitoring wells MW5 and MW6, which had been installed in 1990 along the eastern side of North Ruggles Street. Both a metal detector and ground-penetrating radar (GPR) were used in the vicinity of the wells. Subsequently, the surveyor was asked to mark the locations using survey data generated from Site maps. Finally, debris, soil and asphalt were removed from the road in the most likely locations identified by the GPR and surveyor. Unfortunately, these exhaustive efforts were not successful in locating these wells.

Prior to well development, a calibrated oil-water interface probe was used to assess the presence or absence of free product in the monitoring wells and the GWCS. Approximately 0.2 feet of LNAPL was detected in monitoring well MW2; as a result, this well was not developed. LNAPL was not present in the other wells. Inspection of wells MW1, MW3, and MW4 indicated that a number of small roots had invaded the wells through the well screens. Thus, these wells, which were installed in 1989 and 1990, required redevelopment before representative groundwater elevations and samples could be collected.

In accordance with the SRI/SRA Work Plan, wells MW1, MW3, and MW4 were redeveloped by surging, bailing, and pumping techniques until the groundwater field parameters had stabilized. Field parameters were measured during development and recorded on Monitoring Well Development Logs that are provided in Appendix E.

Following development, the well depth was measured to confirm well construction information, which is summarized in Table 2-4.

2.5 Groundwater Elevation Measurements

Groundwater elevation measurements were collected during all phases of the SRI to evaluate the hydrogeologic conditions, determine the groundwater flow direction, and calculate hydraulic gradients. The existing wells and the GWCS manhole were surveyed prior to collecting water-level measurements. Water levels were measured in Site wells MW1, MW2, MW3, and MW4; the GWCS; and the off-Site NBIA monitoring wells $MW2S_{RI}$ and $MW4S_{RI}$. At MW2, LNAPL thickness and depth to water were measured using a calibrated oil-water interface probe, and groundwater elevations at MW2 were corrected to account for the density of the LNAPL.

The hydraulic gradient in Bronson is low, and, after initial measurements, it became apparent that additional control points were necessary, particularly since monitoring wells MW5 and MW6 could not be located. Three temporary piezometers (designated ETPZ3, ETPZ13, and ETPZ16) were installed at locations ETBR3, ETBR13, and ETBR16, respectively, to provide additional measurement locations near the southeast, northwest, and northeast corners of the facility (Figure 2-2). Construction specifications for the temporary piezometers are summarized in Table 2-4; well logs and a summary of the piezometer construction details are included in Appendix E. Water levels measured after July 14, 2003 included the three new temporary piezometers. Water levels were recorded on Water Level Data Summaries and are included in Appendix E.

2.6 Groundwater Sampling Locations and Methodology

To evaluate groundwater quality, vertical aquifer sampling was performed at 23 sample locations during the first two phases of SRI activities (Figure 2-2). Geoprobe® borings ETBR1-ETBR23 were installed in locations chosen to determine the groundwater quality beneath the former facility, as well as to define groundwater conditions upgradient and downgradient of the Site. Locations ETBR1 through ETBR16 were installed during Phase I activities to provide an overall sampling grid and establish groundwater concentrations beneath, as well as upgradient and downgradient of the former Bronson Reel facility. A finer sampling grid was established in the north-central portion of the facility during the second phase of the SRI activities with the installation of ETBR22 and ETBR23. Current conditions at and near MDEQ's previously installed GPW4 also were assessed during Phase II activities with the installation of ETBR17 and ETBR21. In addition, the second phase of field activities included three additional upgradient sample locations (ETBR18 through ETBR20) to further define groundwater quality east of the Site.

At each of the 23 locations, groundwater samples were collected from multiple depths providing a vertical profile of groundwater quality from the water table down to the till. The five shallowest depth intervals were 8-12, 14-18, 22-26, 30-34, and 38-42 feet bgs. The sixth depth interval was generally from 46-50 feet bgs, but ranged from 43.9-52 feet bgs based on the depth of the till. If the till was encountered at a depth greater than 52 feet bgs, a seventh groundwater sample was collected. In all cases, the deepest groundwater sample was collected directly above the surficial aquifer/till interface.

Prior to August 20, 2003, the groundwater samples were collected from the Geoprobe® sampling tool using the low-flow sampling procedures outlined in the SRI/FFS Work Plan. When the screen was exposed with the rods extended to the base of the surficial aquifer, however, the pressure from 40 feet of hydraulic head caused the groundwater from the surrounding aquifer to rush into the rods. Purging groundwater with the tubing set at the screen level required up to 5 hours for the fine aquifer materials to settle out of the water column before groundwater samples could be taken that met the requirement of 5 nephelometric turbidity units (NTUs). After evaluation, testing, and numerous conversations with EPA and MDEQ personnel, MDEQ approved a modification that resulted in a much faster reduction in turbidity (MDEQ, 2003). The modification allowed pumping from the top of the water column at a rate of up to 1 liter per minute during initial purging to remove fine-grained particulate matter from within the Geoprobe® rods. MDEQ approved this change provided that the increase in the groundwater purge rate did not result in additional drawdown of groundwater within the rods. After the groundwater initially cleared, the tubing was lowered down to the screened zone, and the pumping rate was reduced prior to measuring and recording field parameters. These modifications were used consistently following MDEQ's approval on August 20, 2003.

Groundwater samples were collected from MW1, MW3, and MW4 during the first phase of field activities. Monitoring wells were purged using the standard low-flow methodology as described in the SRI/FFS Work Plan. A groundwater sample was not collected from MW2 because of the presence of LNAPL.

All of the groundwater samples collected during Phase I activities were tested for the presence of VOCs, diesel range organics (DRO), metals, hexavalent chromium, and total cyanide. The groundwater samples collected during the second phase of sampling were analyzed for VOCs, DRO, and metals. Hexavalent chromium was not present in any of the samples collected during the first phase of sampling, and total cyanide was present only at low concentrations. Therefore, these analyses were eliminated for the Phase II samples with the approval of EPA and MDEQ. Every groundwater sample was tested in the field for the following groundwater indicator parameters: pH, specific conductivity, turbidity, dissolved oxygen (DO), temperature, and oxidation-reduction potential (ORP). Measurements were recorded on the Groundwater Sampling Logs included in Appendix E.

2.7 Other SRI Field Activities

2.7.1 LNAPL Characterization

An LNAPL sample was collected from monitoring well MW2 and submitted for fingerprinting to identify the physical characteristics of the floating product.[10] The sample also was tested for the presence of VOCs to determine if solvents were associated with the LNAPL. Approximately 3.7 inches of product was present in MW2 on August 6, 2003, when the LNAPL sample was collected. The product did not recharge quickly into the well, and it was difficult to obtain a sufficient volume for analysis. At the

[10] At the request of the agencies, ITT has undertaken the SRI investigation that includes petroleum hydrocarbons. It is expected, however, that the responsibility for addressing the TPH and LNAPL will fall to others, including the current owner and operator of the Site, and the other prior owners and operators of the Site after 1963, which may be responsible for releases of TPH on the Site.

request of the EPA project manager, sample collection continued over two days to try to accumulate enough sample for the agencies to perform an independent analysis of the LNAPL. After two days, however, sufficient quantity was not present to split the sample with agency personnel. MDEQ staff, instead, collected a groundwater sample that contained a small amount of product from MW2 and analyzed the sample for VOCs and SVOCs. The results of this analysis are included in Section 5.3 below.

2.7.2 Survey of the City's Industrial and Storm Water Sewers

During Phase II SRI field activities, an industrial and storm water sewer survey was performed to identify the location and condition of these features in the vicinity of the Site. Manhole covers for the industrial and storm water sewers were removed to observe the depth, direction, and size of the entry and exit pipes. A remote video survey was conducted in the city's industrial sewer east and north of the Site, as well as the section running north from Mill Street. In addition, a remote video survey also was performed in the northern portion of the storm water sewer located along the western Site boundary beneath North Ruggles Street. Sewer features documented during the sewer survey are presented on Figure 2-3; the results of the sewer survey are summarized in Appendix F.

2.7.3 Surveying

A Michigan-licensed land surveyor, KEBS, Inc., surveyed the Site features, existing well locations, and sample locations. Horizontal locations were surveyed in accordance with the Michigan State Plane Coordinate System North American Datum (NAD 83). Vertical elevations were surveyed in accordance with the North American Vertical Datum (NAVD 88). The survey data and map are provided in Appendix G.

2.7.4 Investigation Derived Waste Management and Disposal

Soil, purged groundwater, equipment decontamination fluids, and materials used during sampling activities were contained in new Department of Transportation (DOT) approved 55-gallon drums and were properly sealed, labeled, and staged at a temporary storage area for investigation-derived waste (IDW). The area, located adjacent to the Site on the north end of North Douglas Street, was secured and barricaded at the end of each day. Appropriate access rights were obtained from the city for these activities.

Representative samples of solid and aqueous IDW were collected for analytical testing at the completion of each phase of field activities. Following receipt of the analytical results, profiles were generated, proper disposal was arranged, and shipping manifests prepared. The IDW drums were transported to The Environmental Quality Company Michigan Disposal Waste Treatment Plant within 90 days of generation. IDW management forms and IDW manifests are included in Appendix H.

2.7.5 Field Methods

The major SRI field activities are summarized in the preceding sections. Activities not specifically described (such as equipment decontamination, Geoprobe® sample collection, sample preservation and handling, and laboratory procedures) were conducted as presented in the EPA/MDEQ approved work plan documents listed in Table 2-1.

3.0 GEOLOGY AND HYDROGEOLOGY

A review of regional geology and hydrogeology provides an enhanced understanding of Site-specific geologic and hydrogeologic data. Although the Site geology is not particularly complex, this review shows that changes in groundwater flow direction have occurred over time, making a hydrogeologic analysis more complicated. A thorough understanding of the relationship between surface water and groundwater, as well as an understanding of the geologic materials through which the groundwater flows, is essential to understanding the fate and transport of contaminants in this environment.

3.1 Regional Geology

Glacial deposits attributable to Pleistocene glaciation cover the Bronson area. At the Site, the surficial deposits consist mostly of sands and underlying clays resulting from the northeast to southwest advance of the Saginaw Lobe during late Wisconsin time (Leverett and Taylor, 1915; Monaghan and Larson, 1986). The Coldwater Shale underlies the glacial deposits at a depth of approximately 150 feet (Milstein, 1987; Warzyn, 1993). This bedrock unit of Mississippian age is 500 to 700 feet thick and is made up of fossiliferous shale containing occasional beds of limestone, siltstone and sandstone (Western Michigan University, 1981; Harrell et al., 1991).

Three distinct glacial deposits occur in the North Bronson Industrial Area: an upper sand and gravel unit, a silt/clay aquitard, and a lower sand and gravel unit (Warzyn, 1993). These glacial deposits represent a sequence of 1) proglacial outwash (lower sand and gravel unit) deposited on the pre-existing land surface as the most recent glacier advanced from the northeast, 2) a lodgement till (silt/clay layer) deposited as the glacier over-rode the area, and 3) recessional outwash (upper sand and gravel unit) as the glacier retreated to the northeast (Figure 3-1).

Just north of the NBIA, a topographically higher, northeast-southwest trending moraine exists (Warzyn, 1993 and Farrand, 1982). Till in the moraine has been mapped as drumlinized ground moraine that was likely deposited during the glacier's advance to or retreat from the Sturgis terminal moraine to the southwest (Richmond and Fullerton, 1983). More recently, Fisher and Taylor (2002) suggest that sub-glacial flooding at the base of the Saginaw Lobe resulted in the formation of these drumlins from a pre-existing moraine.

3.2 Regional Hydrogeology

The Site is located in the St. Joseph Watershed. Man-made CD30 discharges to Swan Creek (Figure 1-1) which is a tributary of the St. Joseph River. The St. Joseph River flows southwest across the northwest corner of Branch County. The Prairie River is located approximately two miles south of the City of Bronson and flows northwest until it joins the St. Joseph River near Three Rivers.

CD30 forms the northern boundary of the NBIA (Figure 1-2). Flow in this unlined drainage canal is to the west, and CD30 receives discharges from Bronson Plating, the Bronson Wastewater Treatment Plant, the storm sewer, and various farm fields located north of the drain. Early investigations of the NBIA indicated that shallow groundwater flow discharged to CD30. More recent investigations indicate that, occasionally, the groundwater system may be recharged by surface water from CD30.

Water table elevations in the vicinity of the former Bronson Reel facility were first measured in the early 1990s as part of the NBIA RI (Warzyn, 1993). A groundwater elevation contour map for April 22, 1992 is typical of the groundwater flow directions measured during the RI (Figure 3-2). The groundwater flow direction during these years was toward the northwest. Groundwater elevation measurements collected in March 2001 as part of the pre-design studies for the NBIA remedy also indicate a flow direction to the northwest. More recent groundwater elevation measurements collected in 2002 and 2003, however, indicate a flow direction to the west-southwest. The groundwater elevation contour map for September 16, 2003 is presented in Figure 3-3.

There is no reason to believe that the groundwater flow directions determined from water-table measurements in the early 1990s or in 2001 were not correct. Instead, it appears that the groundwater flow direction is somewhat variable over time. Not enough groundwater elevation data have been collected consistently over a long period of time to determine whether flow is more often to the north-northwest or to the west-southwest or how long these flow patterns typically last. An examination of the data, however, indicates that during periods of relatively high water levels, groundwater discharges to CD30, and groundwater flow in the NBIA is toward the northwest. When water table levels are lower, groundwater flow is toward the west-southwest. This pattern is demonstrated in graphs of water table elevations at NBIA Monitoring Wells MW-5S and MW-10S (y-axis) through time (x-axis), with blue arrows indicating the flow direction (Figures 3-4 and 3-5). These graphs show that when groundwater elevations are higher (generally above 904 feet amsl), flow is to the northwest. This is also illustrated on Figures 3-2 and 3-3. When groundwater elevations are lower (generally below 904 feet amsl), as observed recently, the flow direction is to the west-southwest in the NBIA.

As suggested above, the periodicity of the changes in flow direction cannot be determined directly from existing potentiometric data. Likewise, those data do not allow estimates of the average groundwater flow direction. Nevertheless, determining the duration of each flow pattern, including identifying which flow pattern has been most persistent, is essential to understanding the past movement of groundwater contaminants. This can be accomplished using an indirect method based on streamflow data that have been collected regularly over many years.

Given that the water table is shallow in this area of Michigan and, as a result, a significant portion of the streamflow in nearby rivers is supported by groundwater (Holtschlag, 1998), high groundwater elevations should correlate with greater streamflow. A summary of a method of correlating streamflow data to groundwater elevations is presented below. A detailed explanation of the calculations is included as Appendix I. Gauges in two nearby rivers (the St. Joseph and the Prairie) record streamflow in cubic feet per second. Streamflow data for these two rivers are available from 1962 to the present. Flow in both of these rivers is primarily supported by groundwater; Holtschlag (1998) calculated that the average groundwater component of streamflow was 90.7 percent for the St. Joseph River and 93.1 percent for the Prairie River. A good correlation, based on regression analyses, exists between mean streamflow in these two rivers and measured groundwater elevations at the NBIA. Regression analyses then were applied to relate the estimated groundwater elevations to groundwater flow direction. These analyses indicate that, from 1962 to the present, groundwater flows to the northwest more often than the west-southwest. The amount of time that flow is estimated to be to the north or northwest is between 58 and 70 percent. Thus, the calculated groundwater elevations indicate that, since 1962, west-southwesterly flow (as observed in 2002 and 2003) has occurred about one-third of the time, and a northwesterly flow pattern has occurred about two-thirds of the time in the central NBIA. Averaged over the long-term, therefore, the cumulative groundwater flow direction is likely to the west or west-northwest in the vicinity of the Site, and the area east to east-southeast of the Site is upgradient.

As discussed above, groundwater flow is generally to the northwest when water levels are higher and the surficial groundwater is discharging to CD30. The high water levels combined with a local discharge point lead to steeper groundwater gradients and, hence, higher groundwater flow velocities when flow is northwesterly. The steepest gradients will occur adjacent to CD30, but steeper gradients may also affect even more distant locations in the NBIA near monitoring wells MW5S and MW10S (Figures 3-4 and 3-5). Thus, the northwesterly groundwater flow regime may have more influence on contaminant migration and regional plume development than west-southwesterly flow, which occurs at a lower gradient.

3.3 Site Geology

During Phase I and Phase II of the SRI, continuous lithologic characterization was performed at 23 Geoprobe® sampling locations. This Site-specific geologic investigation confirms the regional picture of a thick sequence of outwash sands and gravels underlain by a continuous till aquitard. A Site cross section location map is presented as Figure 3-6, and cross sections are presented in Figures 3-7 through 3-10. The geologic materials encountered in the investigation consist primarily of well graded fine to coarse sand with various amounts of gravel and trace amounts of silt. Vadose zone soils are primarily sand and gravel with varying amounts of interstitial silt and clay. The upper portion of the vadose zone typically contains slightly more silt or clay in the sand and gravel matrix than the saturated upper sand and gravel unit. At some locations, vadose zone soils occasionally contain other materials such as coal and slag fragments mixed with the soil. Gravel is present in two distinct horizons. There is a fairly thin layer of sand containing 15 to 25 percent gravel identified in many of the borings between 7 to 12 feet bgs at an elevation of about 900 to 905 feet amsl. A thicker unit of sand and gravel is found generally near the base of the borings from about 865 to 885 feet amsl. This unit contains various amounts of gravel, ranging from 15 percent to more than 50 percent.

A silty clay till was encountered at the bottom of every boring at depths ranging from 47.1 to 56.7 feet bgs. The thickness of this till unit at the Site has not been explored; however, the boring log for the City of Bronson Well No. 3, located approximately 2,000 feet to the east-northeast, indicates the till unit is 17 feet thick. There is approximately 10 feet of relief on the top of the till across the Site, from 856.11 feet amsl at ETBR3 in the southeast corner to 865.77 feet amsl near the northeast corner of the Site. A contour map of the top of the till is presented in Figure 3-11. The highest elevation of the till is located across the northern portion of the Site. Five of the ten borings located in this area contained gravel units with greater than 50 percent gravel. Only one other boring (ETBR11) contained a gravel lens. Thus, a higher percentage of gravel in the outwash appears to be associated with the higher elevation of the aquitard in the northern portion of the Site.

3.4 Site Hydrogeology

There are no surface water features on the Site. The storm sewer survey conducted as part of this investigation indicates that storm water runoff from the Site enters the storm sewers on North Douglas, State, and North Ruggles Streets east, south, and west of the Site, respectively (Figure 2-3). The storm sewer is constructed at a depth of approximately 4 to 8 feet bgs. Before reaching the Site, water in the storm sewer flows west along West Railroad Street, then south along North Douglas where it joins a larger storm sewer (36-inch) that flows west along State Street. At North Ruggles, the storm sewer joins a 48-inch sewer that continues north across Mill Street (Appendix F). The exact location of the storm sewer beyond this point was not explored during the SRI, but figures from other sources indicate it does continue north, crossing beneath the western lagoons and discharging to CD30 just to the north of the western portion of the western lagoon area.

Wastewater from plant operations from 1939 through 1969 was discharged to the city's western industrial sewer. (Certain cyanide-containing wastes were discharged by Old Bronson Specialties, Inc. to the western lagoons until at least 1973). This industrial sewer consists of vitrified clay pipe approximately 3 to 4 feet bgs. Before reaching the Site, the industrial sewer runs west along West Railroad Street. The industrial sewer upstream from the Bronson Reel Facility received wastewater discharges from the former LA Darling facility and the former Scott Fetzer facility from 1939 to 1949. At North Douglas Street, just east of the Site, the industrial sewer jogs north and then turns west across the northern portion of the Site (Figure 2-3 and Appendix F). The section of the industrial sewer located west of the main manufacturing building on the Site was removed and capped during excavation activities completed during 1989 to 1990. A description of this removal action is included in Section 1.4.3. The remaining portion of the western industrial sewer continues north along the east side of the H.G. Geiger Manufacturing Company. Wastewater carried by the western industrial sewer was discharged into the western lagoons.

Groundwater in the surficial sand and gravel aquifer occurs under unconfined (water-table) conditions. Water level measurements are provided in Table 3-1. Figures 3-12 and 3-13 illustrate the water table surface and groundwater flow directions using water-level measurements collected on September 13, 2003 and January 22, 2004, respectively. The groundwater flow direction on September 13, 2003 was primarily toward the west-southwest. Groundwater levels measured on January 22, 2004 were above 904 feet amsl and higher relative to those measured the previous September, and the groundwater flow direction was toward the northwest. These data provide supporting evidence to the regional evaluation presented previously that groundwater flow is toward the northwest when groundwater levels are higher and shifts toward the west and southwest when water levels fall.

The water table surface reflects the Site topography and is only slightly inclined. The hydraulic gradient beneath the Site was calculated to be 0.00023 feet per foot on September 13, 2003 and 0.0003 feet per foot on January 22, 2004. Slug tests were conducted in shallow monitoring wells in the vicinity of the Site during previous investigations (Warzyn, 1993). The geometric mean of the hydraulic conductivity values from these tests is 138 feet per day. Using the gradients measured on September 13, 2003 and January 22, 2004, an effective porosity of 0.25, and a hydraulic conductivity of 138 feet per day, groundwater velocities were calculated using the following equation:

$v = KI/n_e$

where:

v	=	groundwater flow velocity (feet per day)
K	=	hydraulic conductivity (feet per day)
I	=	hydraulic gradient (feet per foot)
n_e	=	effective porosity

The groundwater flow velocity was calculated to be approximately 46 feet per year using the data from September 13, 2003 and approximately 60 feet per year using the data from January 22, 2004. Note that the northwesterly flow conditions on January 22, 2004 included a steeper hydraulic gradient (and higher velocity) than the southwesterly flow conditions on September 13, 2003. As discussed above, this is likely a general trend for the NBIA as a whole.

4.0 ANALYTICAL DATA

The AOC, SOW (EPA, 2002b) and SRI/FFS Work Plan for NBFF OU1 (Earth Tech, 2003a) state that screening-level data collected during the SRI will be used in conjunction with historic data to evaluate the nature and extent of, and risks associated with, COCs found at the facility.[11] Before completing this SRI, a significant analytical data set already existed as a result of the investigations and remedial work that was conducted from 1988 through 1990. A considerable number of soil samples were collected and analyzed for organic and inorganic constituents as a result of these early efforts. As a result, the complete soil data set evaluated during the SRI included historic soil data as well as the soil data collected during the SRI. The amount of groundwater data collected from 1989 to 1990 from the Site monitoring wells was limited and is not included or evaluated further in this report. The early groundwater samples were eliminated because the large number of groundwater samples collected during the SRI provides excellent areal coverage and represents current groundwater conditions. The historic soil data and all of the SRI data were reviewed to determine their suitability for evaluating Site conditions.

4.1 Historical Soils Data

From 1988 through 1990, over 80 soil samples were collected from 40 locations at NBFF OU1; subsets of these samples were tested for metals, VOCs, TPH, SVOCs, and polychlorinated biphenyls (PCBs). The sample locations, which are north, west and south of the main building, are shown in Figure 4-1; the analytical results are presented in Tables 1-1 to 1-6; and the laboratory results are in Appendix D.[12] Soils from nine of these sample locations were excavated during this early time period.[13] Because these soils were ultimately removed, the analytical results from these samples were eliminated from the data set that was used to evaluate current Site conditions and risks associated with those conditions. These results, however, are presented in italics in the summary tables and can be compared to results for those soils that remain at the facility.

Laboratory and field quality assurance (QA)/quality control (QC) information is not available for the data collected from 1988 through 1990.[14] The data were collected, however, in cooperation with and under the review of MDEQ; as such, it is expected that appropriate methods were used to achieve acceptable screening-level data. The data were reviewed for the most basic validation criteria (known location, depth, and sample date); results were considered sufficient to evaluate the condition of the remaining soils if this fundamental information was available. Sample depth was not available for ten samples

[11] Section I of the SOW, entitled Purpose, states "This additional work is to be completed in the SRI through the collection of screening level data, such as hydropunch samples for groundwater evaluation, and soil samples." In addition, the second paragraph of the same section states "The SRA will utilize data from past investigations as well as from the SRI, but will not evaluate risks related to contamination in soils that have already been excavated and removed."
[12] PCBs were not detected, so a summary table is not included; however, the laboratory reports are included in Appendix D.
[13] Soil samples collected at the following locations were subsequently removed during excavation: B1, B3/4, B4 through B8, $NE_{Corner2}$, and $SE_{Corner2}$.
[14] This work was conducted by the property owner at that time and was performed without ITT's knowledge or oversight.

collected from ten locations which are all located east and north of the storage building.[15] As a result, these ten samples were eliminated from the data set.[16] To replace these samples, new soil samples were collected in this area during the SRI.

As the historic soil data are discussed in the following sections, it is important that the reader understands that the analytical results only represent a fraction of the soil currently in the yard area. In fact, 70 percent of the soil in the yard area has been removed, generally down to the water table. When considering nature and extent, average soil concentrations, risk concerns, and exposure scenarios for metals in soils, it is important to keep in mind that most of the yard material is backfill material.

4.2 Data Collected During the SRI and Data Validation

Analytical testing methods for soil and groundwater samples collected during the SRI are summarized in Tables 2-2 and 2-3, respectively. Environmental samples were analyzed by PEL Laboratories, Inc. located in Tampa, Florida. Information regarding the sample collection was recorded on Daily Quality Control Reports (DQCRs) that are provided in Appendix E. The field measurements, sample collection and management procedures, number of samples collected from each medium, and number of QC samples obtained are documented in these reports.

The analytical data generated during the SRI were validated using the criteria described in the Revised Quality Assurance Project Plan (QAPP) for the former Bronson Reel facility (Appendix C of Earth Tech, 2003a) and other relevant documents.[17] About 15,000 analytical results from 166 groundwater samples and approximately 1,700 analytical results from 38 soil samples, including their associated QA/QC samples, were obtained during this SRI. Earth Tech performed an independent QC check of both the field and laboratory procedures that were used during sample collection and analysis. The results are presented in the following tables:

- Table 4-1: VOCs in Soils
- Table 4-2: Inorganics in Soils
- Table 4-3: Groundwater Indicator Parameters
- Table 4-4: VOCs and TPH as DRO in Groundwater
- Table 4-5: Inorganics in Groundwater
- Table 4-6: LNAPL Analyses

[15] Sample depth is considered an important QA/QC criterion for the following reasons. First, in order to evaluate exposure scenarios and associated risks, it must be known whether the concentration is representative of surficial or subsurface conditions. In the same manner, if the sample represents an area to be remediated, sample depth is necessary to evaluate remedial alternatives. Finally, soil samples collected from 6 to 10 feet bgs may have been in contact with groundwater when they were collected (depending on the groundwater elevation) and concentrations may be representative of groundwater conditions and not soil conditions.

[16] 'Data set' is used to describe the final data set that is used to evaluate the nature and extent of compounds at and near the Site. The same data set, minus those compounds in groundwater that originate from upgradient source(s), is used to evaluate risks associated with soils and groundwater at the Site.

[17] Other documents include the following: QAPP Addendum for the former Bronson Reel facility (Earth Tech, 2003b), EPA National Functional Guidelines for Inorganic Data Review (EPA, 2002a), and EPA National Functional Guidelines for Organic Data Review (EPA, 1999)

If the analyte was not detected in the sample, the result is reported as less than ("<") the laboratory reporting limit, which is given as a numeric value. The reporting limit represents the value at which the results can be considered quantitatively accurate. This value is usually set at least twice the method detection limit and accounts for sample dilution and smaller quantities of sample. If the analyte is present at concentrations between the method detection limit and the reporting limit, it is reported as present (no "<" symbol is used), but the result is assigned the laboratory qualifier "J". The data included in the tables have three fields for data qualifiers, and the first field represents the laboratory qualifier. The following two fields (all fields are separated by a "/") are used for qualifiers assigned by Earth Tech. The second field is used by Earth Tech to apply additional data qualifiers that result from their review of all the data, including associated field QC samples that were not identified as such to the laboratory. The third field is a descriptor field used by Earth Tech to describe the analytical problem more specifically. All of the data qualifiers are described in Table 4-7. If no letter is present after the reported numeric result, the analysis met all of the highest QA/QC standards, and no qualifier was assigned.

The quality control checks verified that the data met the Data Quality Objectives (DQOs) and could be used to estimate soil and groundwater conditions at and near the Site.[18] All of the groundwater and soil results are considered useable, as are the LNAPL analytical results. Following review of the associated blank samples, some groundwater results were labeled with an L in the third descriptor field to indicate the analyte was present in the sample at low concentrations compared to that found in the blank. In some cases, the analyte was ultimately considered as not detected, based on other QA/QC factors. Data considered as not detected based on the QA/QC review are highlighted in the analytical summary tables. Concentrations of duplicate samples were compared as part of the QA/QC review. The maximum value of the primary sample and duplicate sample was used to evaluate the nature and extent of an analyte; the maximum was also used in the SRA. A detailed discussion of the data validation and data qualifiers for the analytical data is provided in the Analytical Data Quality Report (ADQR) provided in Appendix J.

MDEQ collected a groundwater sample at MW2 during the SRI. Although QA/QC data were not provided, it is assumed that the results are acceptable as screening-level data. The results of MDEQ's analyses are provided in Table 4-8.

4.3 Background and Upgradient Samples

As discussed previously in this report, it is likely that the groundwater flow direction in the vicinity of the former facility varies over time. Groundwater elevations measured at and near the facility during the summer of 2003 indicate flow was generally toward the west-southwest; groundwater elevations in late 2003 and 2004 indicate a northwesterly flow direction. During times when the water table elevation was higher, flow in the NBIA was to the northwest. Thus, if groundwater quality at the facility is affected by upgradient sources, those sources may be located in an arc extending from east-northeast to the southeast of the facility. Based on the variable groundwater flow patterns, it is likely that groundwater plume(s) originating in the NBIA would occur over a broad area extending northwest to west-southwest from the source(s). In fact, the shape of the plume would indicate the dominant groundwater flow direction based on contaminant

[18] Of the 14,818 groundwater samples, only 7 groundwater TPH-DRO samples are considered invalid because of the low recovery for a laboratory control sample; these samples were rerun, and the subsequent results are valid.

concentrations. In general, the average groundwater flow direction is thought to be west to northwest in the southern portion of the NBIA; in the northern part of the NBIA, the dominant flow direction is more to the northwest because of the presence of CD30.

Background soil samples were collected east of the Site along North Douglas at ETBR18, ETBR19, and ETBR20. Although these samples are located in grassy areas east of the facility, they do not represent 'pristine' conditions because of the proximity of industrial properties in the area. Nevertheless, the soil samples were collected in areas far enough from the industrial activities that they represent soil conditions that have not been affected directly by any incidental releases of compounds.

Groundwater samples collected northeast, east, and south of the facility building are considered upgradient of the facility operations. Offices are located in the south end of the building, and a paved parking area exists between the building and the road so it is not expected that facility operations have affected soils or groundwater in this area. Similarly, the area east of the main building is adjacent to the street and is landscaped and maintained. Although this area may have been used for parking, it is unlikely that chemical handling occurred in this area. In the following sections, groundwater samples collected at ETBR1, ETBR2, ETBR3, ETBR15, ETBR16, ETBR18, ETBR19, and ETBR20 are considered upgradient, particularly when discussing compounds such as VOCs that are known to travel significant distances in groundwater. When discussing metals in groundwater, however, inorganics detected in samples collected at these same locations may also be referred to as background concentrations.

5.0 NATURE AND EXTENT

The AOC and SOW specify that ITT's responsibility is limited to evaluating and addressing only those compounds that originate on the Site and were not sourced from the city's industrial sewer.[19] ITT is not required to address contaminants from upgradient sources or those that originate from the industrial sewer, if any. Contaminants that have migrated to the Site from other sources including from the Scott Fetzer and LA Darling facilities, which are located upgradient (east) of the Site, are to be addressed under different and perhaps future operable units.[20]

The analytical data collected during the SRI, along with historic soil data, were evaluated in regard to the goal defined in the AOC: **to determine if the Site is a source of TCE to groundwater.** The Site data set is now more than sufficient to answer this question. In addition to testing for possible Site sources during the SRI, groundwater samples were collected north and northwest, as well as east of the facility. These off-Site samples provide information about the origin and fate of VOCs in groundwater.

The geologic, hydrogeologic, analytical, and physical data collected at the Site were evaluated and used in conjunction with NBIA regional data to determine the most likely source(s) of the compounds detected in groundwater beneath the Site. In particular, upgradient data collected during the SRI were used along with the analysis of groundwater flow direction and existing NBIA analytical data to determine whether VOCs, particularly TCE, originated at NBFF OU1 or at upgradient sources. The analyses described below clearly demonstrate that VOCs, with the exception of tetrachloroethylene (PCE), originate from sources located upgradient of NBFF OU1.

5.1 VOCs in Soil and Groundwater

All compounds are evaluated in the SRA Section of this report (Section 7.0), whether or not their nature and extent are discussed below. The discussion of the occurrence of VOCs in soil and groundwater (as well as metals and TPH) is focused on those compounds that are present in a significant number of samples at concentrations above both the reporting limits and background levels. This format allows the reader to focus on the primary analytes of concern, i.e., those found at the highest concentrations over the largest area.

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[19] Section III of the AOC, entitled Statement of Purpose, contains the following language: "In entering into this Consent Order, the objectives of EPA and the Respondent are: (a) to determine the nature and extent of TCE contamination in groundwater caused by the release or threatened release, if any, of TCE from [NBFF] OU1 (excluding the industrial sewer) by conducting a remedial investigation; (b) to determine and evaluate alternatives for remedial action (if any) to prevent, mitigate or otherwise respond to or remedy identified risks from [NBFF] OU1 related contamination other than that determined to be caused by the industrial sewer or other off-Site sources; and (c) to provide for the recovery of response and oversight costs incurred by EPA with respect to this Consent Order."

[20] NBFF OU2 and OU3 were established to investigate and address source areas at these former facilities. In the future, an additional OU is planned to address contaminants that have migrated from these facilities and affected regional groundwater. NBIA OU2 has been identified by EPA to address contamination originating from the western industrial sewer only. EPA and the PRPs agreed to terminate negotiations regarding the NBIA OU2 and proceed with investigations at the NBFF.

5.1.1 VOCs in Soils

During the 1989 to 1990 investigation and remedial work, VOC analyses were conducted on 36 soil samples from 23 locations either outside of the excavated areas or from sidewall samples (Table 1-6, Figure 1-8). As described previously, ten samples from ten locations east and north of the storage building have been eliminated from the final data set because the sample collection depths are unknown. During the SRI work, 20 soil samples from six locations were collected on and just north of the property in this same area to replace these samples in the data set. In addition, background soil samples were collected east of the facility at ETBR18 to ETBR20. The SRI soil VOC sample results are included in Table 4-1; the sampling locations are shown in Figure 2-1.

As listed on Table 5-1, thirteen VOCs have been detected in soils at the former Bronson Reel facility. Four of the VOCs, carbon disulfide, carbon tetrachloride, chloroethane, and chloroform, were only present in one sample, so their extent in Site soil is extremely limited. Styrene was present in three samples, but only at low estimated concentrations (below the detection limit of 0.5 µg/kg) and, as a result, is also limited in extent. Two other VOCs, acetone and methylene chloride, are most likely the result of laboratory contamination of the samples. Acetone, for example, was detected at similar concentrations in both the background and Site soil samples collected during the SRI. Methylene chloride was present in 11 of the 1989/1990 soil samples, but was only detected in one of the recent samples at an estimated concentration of 0.48J µg/kg. Because methylene chloride was absent in the more recent samples, it is likely that its presence in the earlier samples can be attributed to laboratory contamination.

Six of the VOCs listed on Table 5-1 are present in multiple samples at concentrations above reporting limits (benzene, ethylbenzene, toluene and total xylenes [BTEX], TCE, and PCE). Although these compounds are detected at concentrations that are below the applicable conservative screening values that are protective of human health (see Section 7.3), they will be discussed below because VOCs are the focus of this SRI. BTEX compounds are associated with TPH and will be discussed later in Section 5.3. The nature and extent of the other two VOCs, TCE and PCE, are addressed in the following section along with their occurrence in groundwater.

5.1.2 VOCs in Groundwater

Historic groundwater samples were not included in the current data set because the number of samples (6 samples from 5 wells) was limited, especially when compared to the extensive number of samples collected during this SRI. The 2003 to 2004 investigation included 162 groundwater samples collected from 23 Geoprobe® locations. Sixty-three of the Geoprobe® samples were collected from nine Site locations, 60 were collected from eight upgradient locations, and 39 samples were collected at six downgradient locations. In addition, four groundwater samples were collected from existing pre-SRI monitoring wells including two Site monitoring wells and one monitoring well located just north of the Site. The groundwater sample locations are shown in Figure 2-2; the analytical results are summarized in Table 4-4.

At least one VOC was present in one or more samples at all of the Geoprobe® locations and monitoring wells tested. Fourteen different VOCs were detected overall. Eight of the detected VOCs occurred in a number of samples; the nature and extent of these eight compounds will be discussed below. Based on similar patterns of occurrence, these compounds can be discussed in three groups: Group 1 – TCE and its associated breakdown products cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride; Group 2 – 1,1,1-TCA and its associated breakdown products 1,1-dichloroethane (1,1-DCA) and 1,1-dichlorethylene (1,1-DCE); and Group 3 – PCE. In the following discussion, VOC concentrations in groundwater will be compared to EPA's MCLs, which are the highest concentrations allowed in public drinking water. These numbers are used for comparison purposes only;[21] comparison to the risk-based screening levels that are appropriate for this Site will be presented in the risk assessment section of this report. Of the eight VOCs listed above, only TCE and vinyl chloride have been detected in groundwater immediately beneath the Site at concentrations above MCLs.

The remaining six detected compounds were present at only low estimated concentrations below the laboratory reporting limit (and below EPA's MCLs). These six constituents are acetone, benzene, 2-butanone, carbon tetrachloride, chloroform, and toluene. These compounds will not be discussed further because it is clear the occurrence and extent of these analytes are limited.

In the following subsections, the occurrence of TCE, 1,1,1-TCA, and PCE in soil and groundwater at the Site will be addressed in detail along with the presence of their associated breakdown products. Furthermore, their concentrations will be compared to those found upgradient of the Site as well as those present at known source areas in the NBIA. With the single exception of PCE, the analyses demonstrate that these VOCs in groundwater beneath the Site are part of a regional groundwater plume that originates at source(s) upgradient and east of the former Bronson Reel facility.

5.1.3 VOC Group 1: TCE and Associated Breakdown Products

During the SRI, TCE was detected in almost all of the 111 groundwater samples collected from 25 Geoprobe® and monitoring well locations. TCE was not found, however, at ETBR8, located on the south side of the facility. The highest concentrations were detected east and northeast of the property in an upgradient direction. The maximum concentration (1,200 µg/L) was found northeast (upgradient) of the property at a depth of 30 to 34 feet bgs at ETBR16. TCE generally occurred throughout the water column in the samples collected north of the Site, as well as in those collected from the northern third of the former facility. In these samples, the highest concentrations were found between 22 and 34 feet bgs. In samples collected across the southern two-thirds of the property, TCE was generally found in shallower groundwater, with the highest concentrations most often present in the 14- to 18-foot bgs sample interval. Concentrations at ETBR19 and ETBR20 were also higher in this same 14- to 18-foot bgs sample interval. Concentrations of TCE detected in groundwater are shown in Figure 5-1. The maximum concentration for all depths was used at each Geoprobe® location to create this figure. The estimated TCE isoconcentration maps for each depth interval are provided in Appendix K. The MCL allowed in drinking water for TCE is 5 µg/L. Much of the groundwater beneath the Site contains TCE concentrations above MCLs.

[21] As described in earlier sections, a soon-to-be enacted groundwater ordinance covering the NBIA will prohibit the use of groundwater for drinking water purposes. In addition, there are no drinking water wells close to the Site (the nearest well is located about 500 feet southwest of the facility). Therefore, drinking water standards are used here as the most conservative standard for comparison; this convention is not meant to indicate, however, that it is an appropriate risk-based screening level for groundwater beneath the facility.

TCE was not present in any of the historic soil samples included in the data set. TCE was present, however, in two historic soil samples that were excluded from the data set because their sample depth was unknown. TCE was present in these two samples at 60 and 110 μg/kg, respectively, collected at S_{W2} and $E(S)_{W2}$ near the northwest corner of the building. Other historic soil samples collected within 20 feet of S_{W2} and $E(S)_{W2}$ did not contain TCE, nor was it detected in any of the soils that were ultimately removed during the 1989/1990 excavation. Furthermore, TCE was present in only one of the Site soil samples collected during the SRI. At ETBR5, located just north of the storage building, TCE was detected at only 2.6 μg/kg in the sample collected from 6 to 8 feet bgs. North of the Site, TCE was present in soils at two locations, ETBR17 and ETBR21. The highest concentrations, 3J μg/kg (8.6 μg/kg in a duplicate) at ETBR17 and 9.1 μg/kg at ETBR21, were found in surficial samples collected down to 2 feet bgs at these locations. TCE was present at concentrations below the reporting limit (<2.0 μg/kg) in deeper samples at these two off-Site locations. All of the detected concentrations of TCE in soils are shown in Figure 5-2.

TCE is not detected in samples collected elsewhere on the Site. For instance, TCE was not present in any of the soil samples from areas that were subsequently excavated. TCE was not present in the sludge samples collected from the catch basins or industrial sewer pipe (Appendix D). TCE was not present in the groundwater sample collected by MDEQ at MW2. TCE was not present in the LNAPL sample collected at MW2. TCE was not present in the pooled storm water sample collected from the metal chip storage area by the Michigan Water Resources Commission in 1975 (Appendix D).

In summary, the extent of TCE originating at the Site is limited as indicated by the following observations: 1) TCE occurs in soils only at low concentrations and only in a few of the numerous samples tested, 2) TCE is not associated with the former metal chip storage area or LNAPL in MW2, and 3) TCE concentrations in groundwater are higher upgradient (east of the facility) than they are beneath or downgradient of the facility. Based on the limited occurrence in Site soils and the plume geometry shown in Figure 5-3, it is apparent that the source(s) for the TCE in groundwater beneath the Site is east of the former Bronson Reel facility. Previously, TCE has been found east of the former Bronson Reel facility at both the Scott Fetzer and LA Darling facilities at concentrations greater than 20,000 μg/L. In 1991, 30,000 μg/L of TCE was detected about 575 feet east of the Site at MW20, which is on the northwest corner of the Scott Fetzer property. In 1999, 43,000 μg/L of TCE was detected about 625 feet farther east at GP-9 on the LA Darling property. These high concentrations indicate that one or more significant source areas are present upgradient of the former Bronson Reel facility.

Travel pathways for TCE from source areas east of the Site may include one or all of the following: direct transport in groundwater; leakage from the industrial sewer; leakage from the storm sewers along West Railroad Street, State Street, or North Douglas Street; and transport with groundwater flowing through the backfill material of underground utilities. Shallower contamination observed over the southern portion of the Site may also result from leaking nearby storm sewer(s) and/or preferential flow through utility corridors.

Cis-1,2-DCE, a breakdown product of TCE, was present in 103 of the groundwater samples collected from 20 of the 26 SRI locations.[22] Although cis-1,2-DCE was not detected in groundwater immediately beneath the facility at concentrations above the MCL of 70 ug/L, it is likely that deeper groundwater beneath the northeastern corner of the facility is affected with concentrations above the MCL. In fact, the highest concentration of cis-1,2-DCE, 760 µg/L, was found northeast of the facility from 30 to 34 feet bgs at ETBR16, which is the same location and depth interval where the highest concentration of TCE was detected. West of the former Bronson Reel facility building, the concentration of cis-1,2-DCE in the groundwater was less than half that detected at upgradient locations. Cis-1,2-DCE was not present at the three Geoprobe® locations along the southern property boundary; in addition, it was not present in the three water table monitoring wells. Both TCE and cis-1,2-DCE concentrations decline from east to west and from north to south across the property (Figure 5-4). Cis-1,2-DCE has not been detected in soils at the Site.

High concentrations of cis-1,2-DCE have been found at LA Darling (6,300 µg/L at GP-9). In addition, 35,000 µg/L of total-1,2-DCE (most of which was likely the more common isomer cis-1,2-DCE) was present at MW20 on the northwest corner of the Scott Fetzer facility in 1991. The data indicate that the presence of cis-1,2-DCE in groundwater beneath and downgradient of the former Bronson Reel facility results from the source(s) of TCE and cis-1,2-DCE at Scott Fetzer and/or LA Darling (Figure 5-4). The cis-1,2-DCE reached the Site through one or multiple pathways including transport in groundwater, through the western industrial sewer or storm sewer which received discharges from these two facilities, or through utility corridors.

Vinyl chloride is also a breakdown product of TCE. It was present in 83 groundwater samples from the same 20 borings where cis-1,2-DCE was detected. Generally, vinyl chloride was present at deeper intervals and at lower concentrations than cis-1,2-DCE. Concentrations of vinyl chloride were higher east of the facility. For example, 42 µg/L was present in the sample collected from 30 to 34 feet bgs at ETBR18, while west of the main facility building, the highest Site concentration was 7.3 µg/L (collected from 30 to 34 feet bgs at ETBR23) (Figure 5-5). Deeper groundwater beneath the northern portion of the facility contains vinyl chloride concentrations above EPA's MCL of 2 µg/L. Vinyl chloride was not detected in soils at the former Bronson Reel facility.

In 1991, vinyl chloride was present at 5,200 µg/L in MW20 at the northwest corner of the Scott Fetzer facility. In addition, vinyl chloride was detected in 1998 at 960 µg/L at GPW-3, which is located on Matteson Street between the LA Darling and Scott Fetzer facilities. It is apparent that vinyl chloride in groundwater beneath the former Bronson Reel facility is due to an upgradient source(s) of TCE, cis-1,2-DCE, and vinyl chloride at Scott Fetzer and/or LA Darling (Figure 5-5). The vinyl chloride reached the Site through transport in groundwater, in sewers, and/or in backfill material for the underground utilities.

Trans-1,2-DCE was present in 61 groundwater samples collected at 17 sample locations during the SRI. The highest concentration detected was 13 µg/L, well below the MCL of 100 µg/L. This concentration was found east of the facility from 22 to 26 feet bgs at ETBR19. Concentrations detected on the Site were less than half of this concentration.

[22] Detected VOC concentrations in groundwater are posted according to their depth intervals on maps that are included in Appendix K.

Similar to the VOCs discussed above, trans-1,2-DCE was not found in Site soils, and concentrations in groundwater decline to the west and south across the facility. Maps showing the detected concentrations of trans-1,2-DCE are included in Appendix K.

Concentrations of trans-1,2-DCE up to 65 µg/L have been identified at the LA Darling facility. It is likely that this compound occurs either as a contaminant associated with the TCE used at that facility or as a breakdown product of the TCE from the Scott Fetzer and/or LA Darling facilities. The source of the trans-1,2-DCE detected in groundwater beneath the former Bronson Reel facility originates at known VOC source area(s) east of the facility.

In summary, it is clear that the TCE, cis-1,2-DCE, vinyl chloride, and trans-1,2-DCE in groundwater beneath the former Bronson Reel facility originate from source(s) east of the Site. This conclusion is based on the following information:

- High concentrations of these VOCs occur in groundwater at Scott Fetzer and LA Darling;
- The highest concentrations detected during the SRI occurred at upgradient sampling locations;
- Concentrations decrease as groundwater moves east to west beneath the former Bronson Reel facility;
- Concentrations also decline from the north to the south in groundwater beneath the former Bronson Reel facility;
- The highest concentrations in groundwater beneath the Site are found deep below the water table; and
- TCE was only present at a low concentration in limited Site soils; cis-1,2-DCE, vinyl chloride, and trans-1,2-DCE were not detected in Site soils.

5.1.4 VOC Group 2: 1,1,1-TCA and Associated Breakdown Products

1,1,1-TCA was detected in ten groundwater samples taken at seven locations installed at and near the former Bronson Reel facility during the SRI activities. The highest concentrations detected were 2.5 µg/L at ETBR16 and 1.7 µg/L at ETBR19; both of these locations are located off-Site and east (upgradient) of the facility. The MCL for 1,1,1-TCA is 200 µg/L. 1,1,1-TCA was not detected in any soil samples.

The highest concentrations of 1,1,1-TCA in the NBIA were found at the Douglas Autotech Plant (formerly Douglas Manufacturing/Scott Fetzer Plant #2), located approximately 900 feet northwest of the former Bronson Reel facility. In 1986, 1,1,1-TCA was detected in groundwater beneath this facility at 66,000 and 73,000 µg/L (MDNR, 1986). Lower concentrations of 1,1,1-TCA have been detected upgradient (east) of the former Bronson Reel facility as follows: 35 µg/L at GPW1 and 14 µg/L at MW19, both near Scott Fetzer, and 15 µg/L at MW1I at LA Darling. Similar to TCE and the other VOCs discussed in the preceding section, the 1,1,1-TCA in groundwater beneath the former Bronson Reel facility originates upgradient of the facility.

1,1-DCE, a breakdown product of 1,1,1-TCA, was detected in 17 samples at seven of the locations sampled during the SRI. The highest concentrations of 4.6 and 4.5 µg/L were detected off-Site and east (upgradient) of the Site at locations ETBR16 and ETBR18. 1,1-DCE was only detected in one groundwater sample on-Site at ETBR22, where 0.49J µg/L was present from 38 to 42 feet bgs. Groundwater underlying the facility is not affected by concentrations above the MCL of 7 µg/L for 1,1-DCE, and 1,1-DCE was not detected in any Site soils. 1,1-DCE has been detected in groundwater at concentrations up to 15 µg/L at L-2 near the Scott Fetzer facility and at concentrations up to 19 µg/L at GP-10 on the LA Darling property. The source of 1,1-DCE in groundwater beneath the Site is upgradient of the former Bronson Reel facility.

1,1-DCA, another breakdown product of 1,1,1-TCA, was present in 12 samples collected at six of the SRI Geoprobe® locations. The highest concentrations, 4.4 and 5.2 µg/L, were present at the same off-Site upgradient locations and depths as 1,1-DCE (ETBR16 and ETBR18, respectively). EPA has not established an MCL for 1,1-DCA, but these *concentrations are well below Michigan's industrial drinking water criteria of 2,500 µg/L.* 1,1-DCA was present at a shallower interval in the south-central portion of the Site yard at a concentration of 1.2 µg/L in the 14- to 18-foot depth interval at ETBR10. 1,1,1-TCA was detected at the same depth interval upgradient of the facility; thus, the 1,1-DCA at ETBR10 probably is a breakdown product of the 1,1,1-TCA found upgradient. 1,1-DCA was not detected in soils at the facility. 1,1-DCA was present at the same locations where 1,1,1-TCA was found near the Scott Fetzer facility. The highest concentration was 32 µg/L at GPW1. The source of the 1,1-DCA at the former Bronson Reel facility is upgradient (east) of the former Bronson facility.

In summary, it is apparent that the 1,1,1-TCA, 1,1-DCE, and 1,1-DCA in groundwater beneath the former Bronson Reel facility originate east of the Site. This conclusion is based on the following information:

- Higher concentrations occur upgradient of the Site in groundwater at Scott Fetzer and LA Darling;
- The highest concentrations detected during the SRI investigation occurred at upgradient sampling locations;
- Concentrations decrease as groundwater moves east to west across the former Bronson Reel facility;
- Concentrations also decline from the north to the south across the former Bronson Reel facility;
- The highest concentrations in groundwater beneath the Site are found in deeper groundwater and not at the water table indicating there is no source on-Site; and
- 1,1,1-TCA, 1,1-DCE, and 1,1-DCA were not detected in Site soils.

5.1.5 VOC Group 3: PCE

PCE was detected in nine groundwater samples (including one duplicate) at eight scattered Site locations during the SRI field activities (Figure 5-6). All detections occurred only in the shallow groundwater samples collected at the water table. The concentrations of PCE in shallow groundwater ranged from 0.4J µg/L to 2.2 µg/L. All detections were below the MCL for PCE of 5 µg/L. PCE was not present in groundwater at any of the upgradient locations east of North Douglas, nor was it found in groundwater downgradient of the Site.

The highest concentration of PCE in groundwater, 2.2 µg/L, was detected at ETBR22, which was installed through the floor of the small Site storage building. PCE was not present in soils at this location (Figure 5-7). PCE did occur, however, at 32 µg/kg in a soil sample collected from 4 to 6 feet bgs at ETBR4, located approximately 15 feet southeast of ETBR22. PCE was present at low concentrations (<5 µg/kg) in the other soil samples at ETBR4 and two soil samples collected at ETBR5. PCE was not present in nearby soil samples collected at ETBR22 and ETBR23.

PCE was not detected in samples taken prior to excavation. PCE was present in only one of the 26 previous investigation soil samples in 1989/1990. The concentration reported in this early sample was 22 µg/kg. This single sample was collected west of the facility fence from 4 to 6 feet bgs at B11 (refer to Figure 1-8 and Table 1-6). PCE was not present in any of the other historic samples that were eliminated from the data set either because they were collected from soils that were later excavated or the sample depth was unknown.

In summary, the low concentrations of PCE detected in Site soils do not cause an exceedance of the MCL in shallow groundwater beneath the Site, and PCE is not detected at all in groundwater samples downgradient of the Site. Furthermore, historic and current concentrations of PCE in soils and shallow groundwater are much too low to account for the presence of TCE (as a breakdown product of PCE) in groundwater beneath the facility. As discussed in earlier sections of this report, the data indicate that TCE beneath the Site is derived from a source located east of the Bronson Reel facility.

5.1.6 Anomalies Noted in the Occurrence of VOCs

The concentration of 3,900 µg/L of TCE in a groundwater sample collected by MDEQ from 22 to 26 feet bgs at GPW4 is not consistent with the past or current chemical data collected at or near the facility. This sample was collected in 1998 by MDEQ. MDEQ field notes and the mobile lab report for the samples collected from GPW4 are included in Appendix D. Additional MDEQ samples collected north, northwest, and west of the facility in 1998 indicated that, although TCE concentrations in the area were generally higher in the 22 to 26 foot depth interval, the highest concentration in other samples was only 160 µg/L (Figure 5-8). The 160 µg/L concentration is comparable to current data collected during the SRI. A review of MDEQ's field notes and Site laboratory records did not indicate any irregularities regarding analysis of the sample at GPW4. The only unusual process noted for the GPW sample collected from 22 to 26 feet was that the sample was only analyzed once at a dilution of 50 times. The dilution factor was decided as a result of an elevated PID reading at that interval. In general, a sample is run initially with no dilution, and if the results indicate dilution is necessary to obtain accurate data within the instrument calibration range, the sample is diluted and re-analyzed. In this case, the sample was never run at its initial concentration. This, however, does not indicate an error in the results; it only means that there is not an undiluted laboratory analysis to compare and verify the results.

SRI sample location ETBR17 was installed as closely as possible to GPW4 using reference photographs and the recollections of Mr. Charles Graff of MDEQ, who was present when GPW4 was installed. The concentration of TCE at the 22- to 26-foot depth interval in 2004, however, was only 45 µg/L (1/86th of MDEQ's earlier sampling result); lower concentrations were found at shallower and deeper intervals. It is not clear whether the earlier detected concentration of 3,900 µg/L was in error, or whether it was an accurate measurement reflecting a change of concentrations in the regional groundwater plume resulting from transient flow conditions. In any case, there has been no indication from historic or current Site soils or shallow groundwater data that a source for TCE exists at the facility that could contribute to a TCE concentration of 3,900 µg/L. Furthermore, the fact that the highest concentrations found in both 1998 and 2004 are at the 22- to 26-foot depth interval, more than 10 feet below the water table, indicates that the source for the concentrations in GPW4 is some distance upgradient of the property. As stated earlier, higher concentrations of TCE and other VOCs are found east of the Site on the LA Darling and Scott Fetzer properties. A concentration of 30,000 µg/L of TCE, for example, was present in a sample collected from MW20 in 1991; this well is located 575 feet east of the Former Bronson Reel facility on the northwest corner of the Scott Fetzer property. Thus it is clear that significant TCE sources exist upgradient of NBFF OU1, and no sources have been found on-Site despite intensive, multiphase investigations.

5.2 Inorganic Constituents in Soils and Groundwater

Although the purpose of the SRI is to evaluate whether there is a source of TCE at NBFF OU1, sufficient data also exists to evaluate the nature and extent of metals in soil and groundwater at the facility. As with the previous section, the data were analyzed to distinguish which metals occur most frequently at the highest concentrations.

5.2.1 Metals in Soils

During the Site investigation that was conducted in 1989 and 1990, 62 soil samples were collected from 31 locations outside the excavated area or from excavation sidewalls and analyzed for cadmium, chromium, copper, lead, nickel, zinc, and cyanide. Five of the samples were also tested for antimony, arsenic, beryllium, mercury, selenium, silver, and thallium. The inorganic analytical results for the historic soil samples are summarized in Tables 1-1 and 1-2. The sample depth is not known for ten of these historic samples, so these samples were not used to evaluate soil conditions or the risks associated with Site soils. The historic sample locations are shown in Figure 1-9. During this SRI, background soil samples were collected east of the facility at ETBR18 through ETBR20 and analyzed for 26 metals and mercury (Table 4-2). Also included on Table 4-2 are the results for six soil samples that were collected and tested for total chromium, hexavalent chromium, iron, and soil indicator parameters.

The following metals occurred at concentrations higher than those found in the background soil samples: arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, and zinc. These metals will be discussed in greater detail below. Antimony, selenium, silver, thallium, and total cyanide were not present at concentrations above reporting limits in the historic samples and will not be discussed further. Similarly, iron was not present in Site samples collected during Phase III of the SRI at concentrations above those found in background samples collected east of the facility. Consequently, iron also will be excluded from further discussion in this section.

5.2.2 Metals in Groundwater

As with the VOCs, the historic inorganic groundwater samples were not included in the data set because the number of samples is limited. All of the 166 groundwater samples collected during the SRI were tested for target analyte list (TAL) metals, and these results comprise the complete data set that represents current groundwater conditions at and near NBFF OU1. Those groundwater samples collected during the first phase of the SRI also were analyzed for total cyanide and hexavalent chromium. Because total cyanide was only present at low concentrations (up to 33 µg/L) below EPA's MCL of 200 µg/L and hexavalent chromium was not present in the Phase I groundwater samples, these analyses were not performed on the Phase II samples. The groundwater sample locations are shown in Figure 2-2, and the analyses are summarized in Table 4-5.

Concentrations for nine metals occurred above laboratory reporting limits and at levels greater than upgradient concentrations. These compounds are arsenic, total chromium, copper, iron, manganese, nickel, silver, total cyanide, and zinc. The other analytes are considered limited in extent because they are not present at concentrations above the reporting limit, occur in only one sample at concentrations above the reporting limit, or are present at approximately the same concentration as those found in groundwater upgradient of the facility.[23] The metals that are excluded on these bases and will not be discussed further are as follows:

Compounds Below Reporting Limit	Compounds in 1 Sample Above Reporting Limit	Compounds About the Same Concentration as Background
Hexavalent Chromium	Antimony	Aluminum
Cobalt	Beryllium	Barium
Mercury	Cadmium	Calcium
Molybdenum	Lead	Magnesium
Thallium	Selenium	Potassium
Tin	Vanadium	Sodium
Titanium		Strontium

Metals which are retained for further analysis are those that occur in both Site soils and groundwater at concentrations that are higher than background levels. A discussion of the minor inorganic compounds (those that occur in just soils or groundwater but not in both at concentrations above background concentrations) is included in Appendix L. The nature and extent of the five constituents that appear in both soils and groundwater at concentrations above background (arsenic, chromium, copper, nickel, and zinc) are discussed below. The following analyses demonstrate that although higher concentrations of these metals occur in the remaining undisturbed or unexcavated yard soils (30% of yard soils or those immediately outside the fence to the north), all shallow groundwater concentrations for metals beneath the yard and immediately downgradient are below EPA MCLs.

5.2.3 Arsenic

Arsenic was found in three soil samples at concentrations above the highest background concentration of 4,850 µg/kg. These soil samples, at concentrations ranging up to 7,500 µg/kg, were collected from the north, south, and east sidewalls of the main excavation in 1989. The north sidewall soil sample was collected at 3 feet bgs, while the other two were collected at 1 foot bgs. Arsenic was present in groundwater upgradient of the facility at ETBR15 at 5.09 µg/L. Arsenic also was present in groundwater samples collected to the north, west, and northwest of the facility. At all groundwater sample locations and depths on-Site, arsenic concentrations were below the MCL of 10 µg/L;

[23] Groundwater samples collected at ETBR1, ETBR2, ETBR3, ETBR15, ETBR16, ETBR18, ETBR19, and ETBR20 were considered as upgradient samples because they were east of the facility building and plant operations.

concentrations ranged from non-detect to 7.98 µg/L. The highest concentration of arsenic in shallow groundwater beneath the Site was 2.43J µg/L in the sample collected at 12 feet bgs at ETBR12. All of the arsenic detections in groundwater at and near the facility that occurred at concentrations above the reporting limit of 5 µg/L were in deeper groundwater (30 feet bgs or greater). The occurrence of higher concentrations of arsenic in deeper groundwater likely results from contact with aquifer materials that contain natural arsenic or from an upgradient source.

5.2.4 Chromium

The maximum concentration of total chromium reported in background soil samples was 17,000 µg/kg (ETBR18 at six feet bgs). Total chromium was reported in numerous soil samples at concentrations above background levels. The maximum detected Site concentration was 280,000 µg/kg, in north sidewall sample #7 at one foot bgs and in the soil sample collected from 6 to 8 feet bgs at MW2. During the 1989 to 1990 investigation, soils were not analyzed for hexavalent chromium. In order to fill this data gap, a third SRI phase was conducted, during which six soil samples were collected from the three locations where the highest concentrations of total chromium had been detected previously. The concentrations of total chromium found previously, however, were not duplicated in the recent SRI samples; the highest concentrations detected in 2004 were approximately one-tenth of the concentrations previously reported (Figure 5-9). For example, the highest concentrations of 22,800 and 29,900 µg/kg were present in samples collected from 2 and 6.5 feet bgs, respectively, at ETBR26, located in the same vicinity as sidewall sample #7 where historic concentrations ranged from 54,000 to 280,000 µg/kg. One explanation for this marked decrease in total chromium concentration is that the early sample locations were not replicated exactly, so the newer samples may have been collected a few feet from the original locations. As a result, the new total chromium samples exhibited concentrations an order of magnitude lower due to the spatial variability of the total chromium concentrations in soil. If this is the case, then high concentrations of chromium appear to be very limited in areal extent. Another possible reason for the difference in concentration may be that a more subjective analytical method was used previously for chromium. This possibility, however, cannot be substantiated since the earlier analytical method is unknown.

Concentrations of hexavalent chromium in the six soil samples collected in 2004 ranged from 252 to 2,550 µg/kg. These concentrations are below screening levels that are considered appropriate for this Site (Section 7.0). Hexavalent chromium was not detected in any of the groundwater samples collected at or near the Site.

Total chromium was detected in the following groundwater samples: a) one upgradient groundwater sample at 2.52 µg/L (ETBR3 from 12 feet bgs); b) three Site groundwater samples at 6.17, 3.63, and 2.14 µg/L (ETBR4 from 12 feet bgs, ETBR23 from 42 feet bgs, and ETBR9 at 12 feet bgs, respectively); and c) one off-Site sample at 9.32 µg/L (ETBR13 from 12 feet bgs). Total chromium also was present in a number of groundwater samples at concentrations below the reporting limit. All of the detections are well below the EPA MCL for total chromium of 100 µg/L. Based on the low concentrations of total chromium in groundwater and the non-detects for hexavalent chromium in groundwater, the chromium concentrations remaining in the soils around the perimeter of the excavation are not a threat to groundwater quality at or downgradient of the Site.

5.2.5 Copper

Copper was detected at concentrations up to 4,400,000 µg/kg in soils outside of the excavated area. The highest concentration was found just north of the Site in a soil sample collected from 0 to 2 feet at MW4. In background soils, the highest concentration found is 67,800 µg/kg. Copper was reported in groundwater at concentrations above the reporting limits ranging from 5.02 to 22.7 µg/L. These are well below the EPA action level for copper of 1,300 µg/L. Based on the low concentrations of copper in groundwater in comparison to the EPA secondary water standard, the copper remaining in the perimeter soils is a not a threat to groundwater quality at or downgradient of the Site.

5.2.6 Nickel

The highest concentration of nickel detected in background soil samples was 18,100 µg/kg. Nickel was found at higher concentrations in a number of Site samples collected from the excavation perimeter and borings. The highest concentration, 740,000 µg/kg, was found in sidewall sample #3, collected at 8 feet bgs from the east wall of the main excavation. Nickel was reported in groundwater samples collected upgradient of the facility at concentrations up to 12.6 µg/L and in groundwater beneath the facility at concentrations up to 24.1 µg/L. Groundwater samples collected immediately north and west of the facility do not contain elevated concentrations of nickel. There is no EPA health-based or secondary drinking water standard for nickel.

5.2.7 Zinc

Zinc was found in a number of Site soil samples at concentrations that were higher than the highest concentration detected in background soils of 78,900 µg/kg. The highest concentration reported on or in the immediate vicinity of the Site was 2,200,000 µg/kg in the surficial soil sample collected at MW4. Zinc was present at concentrations up to 28.7B µg/L in groundwater beneath the facility; however, zinc was present in the QA/QC blanks for almost all of the groundwater samples, so it is not clear whether concentrations in groundwater are elevated in relation to background concentrations. The groundwater sample from 38 to 42 feet bgs just north of the Site at ETBR17 was not qualified; in this sample, zinc was present at 14.2 µg/L. Zinc was present at 17.7B µg/L in one upgradient shallow groundwater sample at ETBR3. There is no MCL for zinc, and the EPA secondary water standard is 5,000 µg/L. All concentrations are well below this aesthetic regulatory standard.

5.2.8 Anomalies Noted in the Occurrence of Metals

Higher concentrations of manganese and, to a lesser extent, iron, occur in shallow groundwater from the center of the yard area at ETBR12 to north of the facility at ETBR14 to ETBR17. These shallow groundwater samples are in an area and at depths where DO concentrations and ORP values in groundwater are depressed because of the presence of dissolved TPH in groundwater (Figures 5-10 through 5-12). It is likely that the biodegradation of petroleum hydrocarbons has created reducing conditions that are contributing to the dissolution of manganese and perhaps iron from the natural aquifer matrix in this area (Figures 5-10 through 5-12). Concentrations of other metals discussed above, such as chromium, copper, nickel and zinc, were not present at elevated concentrations in groundwater in this area. These metals were generally present only in shallow soils, and concentrations decreased significantly with depth prior to reaching groundwater. Furthermore, the soils have been removed generally down to the water table in this area.

Some of the highest concentrations of inorganic compounds in upgradient shallow groundwater were detected near the southeast corner of the property at ETBR3. These compounds include aluminum, cadmium, total chromium (although the result was qualified with a B), sodium, strontium, vanadium, and zinc. There were no Site operations on this portion of the property; in fact, the offices have been located at the southeast corner of the building since it was constructed. It is likely that the source for these constituents is the storm sewer along State Street that connects to other former facilities to the east.

Another groundwater sample with anomalous metals results was collected from 38 to 42 feet bgs at ETBR23 between the main facility building and the storage building. This Site sample contained the highest metal concentrations for the following constituents: aluminum, beryllium, cadmium, lead, silver, tin, and vanadium. Since elevated concentrations were not found in shallower groundwater at the same location, it is not likely that the compounds in this sample are related to Site activities. In addition, these inorganics are not found in groundwater immediately downgradient of the facility at concentrations that exceed EPA or Michigan health-based criteria for public drinking water.

The surficial soil sample (0 to 2 feet bgs) collected off-Site in the railroad right of way at MW4 contained the highest concentration in soils for copper, lead, and zinc and the second highest concentration for nickel. A deeper soil sample collected from 4 to 6 feet bgs at the same location demonstrates that the concentrations decline with depth. With the exception of nickel, deeper concentrations were all lower than the highest concentration found in background samples. Furthermore, none of the compounds were detected above reporting limits in the groundwater sample collected from the water table at MW4. The data presented in the table below demonstrate that the elevated concentrations of these metals in surficial soils at MW4 do not adversely affect deeper soils or groundwater.

Compound Detected in Soils at MW4	Concentration (µg/kg) 0 – 2 feet bgs	Concentration (µg/kg) 4 – 6 feet bgs	Concentration in Groundwater (µg/L)
Copper	4,400,000	22,000	<5
Lead	180,000	5,700	<5
Nickel	710,000	33,000	<5
Zinc	2,200,000	50,000	2.7J/B/LB*

*The qualifier J indicates the compound is reported at an estimated concentration below the laboratory reporting limit, and the qualifier B indicates the compound was also present in the associated blank.

5.3 TPH as LNAPL and in Soil and Groundwater

During a 1988 site inspection of Bronson Precision Products' operations, the Branch, Hillsdale, St. Joseph District Health Department noted that cutting oils were allowed to drain onto the ground from a metal shavings bin stored in the yard. Subsequent excavation activities by the Site owner Kuhlman/New BSI, initially conducted to remove metals in shallow soils, continued down to the water table in most of the yard area because of the presence of oil-stained soils. During the excavation activities other potential sources of TPH also were removed. An 8,000 gallon UST that originally held #2 fuel oil and later held cutting oils was excavated from the north-central portion of the yard area. In addition, an oil-water separator was removed from the center yard area. At that time, an oil sheen was noted at the base of the excavation, and a GWCS was installed prior to backfilling.

Following the remedial activities, residual TPH remains in soils around the perimeter of the excavation, as LNAPL at MW2, and dissolved in groundwater beneath the yard area. Samples collected during this SRI help define the nature and extent of the petroleum hydrocarbons at the facility. The TPH, however, is not a CERCLA hazardous substance, and it is expected that any concerns regarding residual TPH at the facility would be addressed separately with the property owner, outside of the Superfund process. Evidence indicates that owners and operators of the Site after 1963 are responsible for TPH releases and that the current owner of the Site is a responsible party under Michigan's Part 201, M.C.L. 324.20101 *et seq.*, with respect to TPH.

5.3.1 LNAPL Characterization

TPH is present as floating product (LNAPL) at MW2 in the southwest perimeter of the Site. When the well was installed in November 1989, the well log noted that "oily product appears on water level tape," although no subsequent mention was made in early reports regarding measurable product at MW2. Groundwater elevation and product thickness were measured from July 2003 through February 2004 using an oil water interface probe (Table 3-1). The greatest thickness of LNAPL (0.31 feet or about 3.7 inches) was measured on August 6, 2003. After collecting a product sample on August 6, 2003, subsequent measurements of LNAPL thickness of 0.05 and 0.03 feet on August 7 and 16, respectively, indicate the product was slow to recover.

The LNAPL sample was analyzed for the following parameters: 1) density, 2) TPH-gasoline range organics (GRO), 3) DRO, 4) VOCs, and 5) PCBs. The density of the product was 0.897 grams per milliliter (g/mL), which is similar to that of heavier weight motor oils. GROs were present at 54,000 µg/kg, and DROs were reported at 780,000,000 µg/kg. These figures indicate that 78 percent of the product was within the diesel range of C10 to C28. The only VOC detected in the LNAPL was ethylbenzene at the estimated concentration of 110 µg/kg. There were no solvents or PCBs associated with the product. This conclusion was confirmed by MDEQ's analysis of groundwater collected from MW2, in which no chlorinated solvents were detected (Table 4-8).

5.3.2 TPH in Soils

The presence of TPH was identified in work performed at the facility in 1988. Soil samples collected from five feet bgs at borings B6 through B8 in the yard area had TPH ranging from 4,120 to 22,810 milligrams per kilogram (mg/kg).[24] These soils were subsequently removed during the excavation. Although the original purpose of the excavation was to remove shallow soils because of the presence of metals concentrations, the depth of the excavation was extended to the water table in most areas because of the

[24] Note that the units for TPH in soils are mg/kg (ppm).

presence of oil. Fifty of the 61 soil samples collected outside of the excavation area tested for TPH contained petroleum hydrocarbons. Two soil samples collected just above the water table along North Ruggles Street had TPH concentrations over 20,000 mg/kg. TPH was present at 22,400 mg/kg in the soil sample collected at B11, located approximately 45 feet north-northwest of MW2, and at 20,300 mg/kg at B12, located another 60 feet farther north.

BTEX compounds are known to be associated with the lighter end (GRO) of TPH. These constituents have been identified in some of the soil samples at the facility that were collected outside the excavation area. The highest concentrations and sample locations are 26 μg/kg benzene and 27 μg/kg ethylbenzene from the south sidewall sample S_{W1} (1 foot bgs) and 100 μg/kg toluene and 460 μg/kg xylenes from B12 (0 – 2 feet bgs).

Five sidewall soil samples were analyzed for SVOCs. Phenols were not detected in these samples. Three phthalates (bis-2-ethylhexylphthalate, butylbenzylphthalate, and di-n-butyl phthalate), which are plasticizers and considered by EPA to be common laboratory contaminants (EPA, 1989a), were present at concentrations up to 2,300 μg/kg in the south sidewall sample S_{W1} (1 foot bgs). Di-n-butyl phthalate was present at lower concentrations in the other samples. It is likely that the presence of these compounds is a result of contamination during sample collection or laboratory analysis.

5.3.3 TPH in Groundwater

TPH was detected in 40 groundwater samples collected from 17 locations during the SRI. In general, TPH was not detected in shallow groundwater east and south of the facility. A single exception is the detection of 210 μg/L of TPH in the water table sample collected immediately east of the building at ETBR15.

The highest concentration of TPH in shallow groundwater (2,600 μg/L) was found north of the facility at ETBR14. On the property, TPH was found consistently in shallow groundwater samples from the center of the yard area across the northwestern portion of the property at concentrations between 190 and 680 μg/L. Other than the three locations immediately north of the facility, the only detection north and west of the property was the low concentration of 100 μg/L at ETBR7, located 400 feet to the northwest. This sample was collected from 30 to 34 feet bgs.

BTEX compounds were not present in groundwater samples collected near or at the facility at concentrations above reporting limits. Groundwater samples were not analyzed for SVOCs.

5.3.4 Anomalies Noted in the Occurrence of TPH

TPH was present in some deeper groundwater samples. For example, at ETBR9, TPH was detected at 210 μg/L at a depth of 38 to 42 feet; however, TPH was not present (< 90 μg/L) in the duplicate sample collected from that same depth. TPH was also present at concentrations ranging from 200 to 340 μg/L in all samples collected deeper than 30 feet bgs in ETBR10 and was present at similar concentrations in the shallower samples. However, the shallow samples were qualified to indicate TPH was also found in the associated blanks. TPH was also found in deeper groundwater at ETBR4 and ETBR14, but was not present at deeper depths in nearby locations. It is likely that the irregular occurrence of TPH found at deeper intervals is from sources that are some distance away, from localized cross-contamination from shallower depths, from other field or laboratory contamination, or from a combination of these reasons. The concentrations are usually less than those detected at shallower intervals.

As mentioned above, the highest concentration of TPH in groundwater, 2,600 µg/L, was found north of the property at ETBR14. An on-Site source for this concentration has not been identified. It should be noted that a Standard Oil facility was located approximately 200 feet northeast of the former Bronson Reel Site from at least 1927 through 1955 (Figure 1-2).

5.4 Summary of the Nature and Extent of COCs Detected At and Near the Former Bronson Reel Facility

Chlorinated solvents exist in groundwater beneath the facility at concentrations above drinking water standards. TCE; cis-1,2-DCE; vinyl chloride; trans-1,2-DCE; 1,1,1-TCA; 1,1-DCE; and 1,1-DCA result from a regional, broad plume that originates east of the Site based on the following observations:

- The few isolated low concentrations of TCE detected in site soils (at 60, 110 and 2.6 ug/kg) cannot account for the concentrations detected in groundwater beneath the Site;
- There is no TCE or other chlorinated solvents associated with the LNAPL found in MW2.
- The highest concentrations beneath the Site are found in deeper groundwater;
- The highest concentrations of TCE and its degradation products detected in groundwater during the SRI were detected at locations upgradient of the Site;
- Concentrations of TCE and its degradation products decrease as groundwater moves beneath the Site; concentrations continue to decrease as groundwater moves further downgradient beyond the former Bronson Reel facility; and
- High concentrations of chlorinated solvents exist east of the facility in identified source areas at LA Darling and Scott Fetzer.

In contrast, there is no known upgradient source for the low levels of PCE detected in soil and shallow groundwater beneath the facility. It is possible that one or more Site operators may have utilized PCE; however, concentrations of PCE in groundwater beneath the Site do not exceed MCLs, and PCE is not detected in groundwater samples collected immediately downgradient of the Site or in deeper groundwater. Thus the low concentrations of PCE present in some Site soils is not a threat to groundwater.

Although some metals (arsenic, chromium, copper, nickel, and zinc) are found in soils around the perimeter of the excavation at concentrations higher than those present in background soils, the extent of soils with elevated concentrations is limited. This is because all of the accessible soils within the fenced yard area have been removed. All that remains, therefore, is a narrow strip near the fence line and building where the excavation could not be expanded. Concentrations of these metals in shallow groundwater beneath the Site are below MCLs that are protective of drinking water. The small amount of remaining metals in soils do not adversely affect groundwater quality beneath and downgradient of the Site.

Petroleum hydrocarbons are present as LNAPL at MW2 and in soils and shallow groundwater at and near the facility. It is likely that these hydrocarbons result from historic Site operations. The suspected source materials, including an UST, yard soils, and a below-grade oil-water separator, were removed in 1988 and 1989. It is expected that TPH concentrations will decline over time as a result of natural attenuation processes. Hydrocarbons detected at low concentrations in deeper groundwater, however, are likely from off-Site sources or are the result of sample contamination.

6.0 FATE AND TRANSPORT OF COCS PRESENT AT THE SITE

Past facility operations may have resulted in low concentrations of one VOC (PCE), TPH, and certain metals in Site soil and shallow groundwater. Other VOCs present in groundwater beneath the facility (TCE, 1,1,1-TCA, and their daughter products) originate from off-property sources. The origin, movement, and attenuation of these VOCs originating from off-Site are discussed first.

6.1 Fate and Transport of Compounds Originating Off-Site

The distribution of TCE and other VOCs in the NBIA is controlled by the following four factors:

1. The nature, location, and duration of releases to the aquifer;
2. The nature of the geologic materials in the aquifer;
3. The rate and direction of groundwater flow; and
4. The type of attenuation processes.

Each of these factors is described in greater detail below.

6.1.1 Nature, Location, and Duration of Releases of VOCs to the Upper Aquifer in the NBIA

The highest TCE concentrations in groundwater have been detected at Scott Fetzer (up to 30,000 µg/L) and LA Darling (up to 43,000 µg/L). Similarly, the highest concentrations of daughter products of TCE (cis-1,2-DCE and vinyl chloride) are also found at these two former facilities. The presence of these daughter products indicates that reductive dehalogenation is occurring, probably as a result of biodegradation. Based on the long history of operations at the Scott Fetzer (Douglas Manufacturing) and LA Darling facilities and the use of TCE degreasers in the operations of both facilities and because no significant remedial actions have occurred at either site, releases to groundwater have been occurring for decades and continue today. As a result, contaminant plumes have developed downgradient of these source areas which affect the NBIA as well as the former Bronson Reel facility.

6.1.2 Nature of Geologic Materials

The upper aquifer at the NBIA exists in a glacial outwash plain. This broad plain has little topographic relief and is composed predominantly of sediments with moderate-to-high hydraulic conductivities. As a result, the water table surface has a low gradient. Plumes that develop in areas of low hydraulic gradients are generally broad because both lateral and vertical dispersion have stronger effects when groundwater velocities are lower.

6.1.3 Changes in Groundwater Flow Direction and Rate

Groundwater flow directions have varied over time throughout the NBIA. It is estimated that in the central portion of the NBIA, groundwater has flowed to the west-northwest or northwest approximately 60 to 70 percent of the time since 1962 (Section 3.2 and

Appendix I). In the northernmost portion of the NBIA, flow is more northerly as groundwater nears CD30, which acts as a discharge boundary during periods of higher groundwater levels. Less frequently, westerly or southwesterly flow has occurred in the NBIA. These directional shifts have a pronounced effect on contaminant plume geometry by broadening the area of affected groundwater in an east-west direction. A review of the hydraulic gradients over time indicates that when groundwater flow is to the northwest, the gradient, although still low, is about double the southwesterly hydraulic gradient (Figures 3-4 and 3-5). The overall effect of these changes in flow direction and hydraulic gradient produces a plume that is broader than expected and has the highest VOC concentrations aligned west-northwesterly from the contaminant sources. Given the location of the source areas at Scott Fetzer and LA Darling and the variability in groundwater flow direction, it is likely that contaminants from these two sites have partially merged, complicating interpretation of the current distribution of VOCs in groundwater.

6.1.4 Type of Attenuation Processes

Reductive dehalogenation, most likely as a result of biological activity, reduces concentrations primarily near source areas where concentrations are high and, in the process, produces daughter compounds such as those detected in the NBIA. A number of processes affect the rate of movement and concentrations of VOCs as they move downgradient in groundwater away from their sources. In general, VOC movement is retarded in comparison to the rate of groundwater flow because the contaminants sorb to soil or carbon particles in the aquifer. The retardation rate of each VOC depends on its individual tendency to sorb to the aquifer material. Dispersion causes VOCs to spread out laterally and vertically, thereby reducing overall contaminant concentrations (although the plume mass is unchanged). The effects of lateral and vertical dispersion in the NBIA are even more dramatic because of the low groundwater flow velocities. Furthermore, as contaminants move downgradient in groundwater away from the source areas, they move deeper in the aquifer as infiltration of water originating above ground reaches the water table. The percolating precipitation may also dilute concentrations in shallow groundwater to some extent. Finally, VOC concentrations are reduced by volatilization to the vadose zone and atmosphere as they move downgradient.

6.1.5 NBIA Plume Geometry

A plume map was created showing the maximum TCE concentrations found over time in the NBIA (Figure 6-1).[25] TCE is the most commonly detected VOC in the NBIA and, as such, presents a reasonable approximation of the actual shape of the NBIA VOC plume(s). The following processes, described above, control the distribution of TCE in the aquifer:

- The plume is a result of multiple sources that have existed over a long time;
- The presence of daughter products indicates that reductive dechlorination is

[25] Unfortunately, there are not sufficient contemporaneous data in the NBIA to create an accurate depiction of the NBIA plume using one sampling event. The data set used was collected over a fifteen-year period. Although VOC source areas have not been remediated at Scott Fetzer and LA Darling during this time, recent sampling indicates concentrations in some areas have declined. Ongoing investigations at these two facilities are being conducted to identify source areas. There is very little soil or groundwater data at the former Scott Fetzer facility, and additional characterization is particularly important at that facility.

occurring at and near the source areas;

- The low hydraulic gradient promotes dispersion, resulting in a broad plume;
- Changes in the groundwater flow direction over time have broadened the plume from east to west;
- TCE moves deeper in the aquifer as it flows away from the source areas;
- Concentrations are attenuated by biodegradation, sorption, dispersion, dilution, and volatilization; and
- Groundwater flow is most frequently to the northwest, and hydraulic gradients are highest under this flow condition, favoring contaminant transport in this direction.

As shown in Figure 6-1, the overall distribution of TCE in the aquifer indicates that the average groundwater flow direction over time has been to the west-northwest. The 1,000 µg/L contour of the NBIA TCE plume reaches nearly to the northeast corner of the former Bronson Reel facility Site. Lower concentrations of TCE as well as other VOCs that are found in groundwater beneath the former Bronson Reel facility are part of this broad NBIA plume that originates from sources east of the Site. The fact that the VOC concentrations existing in groundwater beneath the Site are higher with increasing depth below the water table (with the exception of isolated detections of PCE below the MCL), in conjunction with the higher TCE levels found at depth in the upgradient SRI samples to the east of the Site, is evidence that the sources for the NBIA plume are located upgradient of the Site.

It is likely that the NBIA plume will persist until its sources are remediated, although attenuation processes are occurring that will reduce VOC concentrations in groundwater downgradient of these sources. Because the source areas have been in place for a number of years, the NBIA plume may have reached a quasi-steady state condition (i.e, reduction of contaminants through attenuation processes equals the contaminant flux into the groundwater system). Even though a somewhat stable condition may exist, observable changes in concentration will continue to be noticeable at the periphery of the NBIA plume because of the variability in groundwater flow direction.

6.2 Fate and Transport of Site-Related COCs and Current Conceptual Site Model

Although regional conditions controlling the fate and transport of chemicals in the NBIA are generally applicable to the former Bronson Reel facility, the extensive amount of data collected at the Site allows a detailed evaluation of the attenuation processes taking place in both soil and groundwater in the vicinity of the Site. Furthermore, as described previously, there are no plumes downgradient of the facility resulting from Site sources. Thus, the following discussion focuses only on possible Site-specific sources as well as soil and groundwater conditions at and immediately downgradient of the Site.

6.2.1 Nature, Location, and Duration of Site-Related COCs and Current Conceptual Site Model

Manufacturing at the former Bronson Reel Company spanned nearly 35 years and was followed by another 29 years of precision metal working by other owners/operators (unrelated to ITT). Similarly, machining of small components resulted in metal scrap that was stored temporarily in bins in the yard. The current Conceptual Site Model (CSM) indicates that cutting oils used in the machining process carried metal fragments from the chips to the yard soil. Over time, infiltrating rainwater carried the tiny metal residues downward in the soil. Soil samples indicate, however, that the metals concentrations generally did not reach deeper than about five feet at the Site. Cutting oils, however, could move through the soil more easily and eventually reached the groundwater table beneath the yard. Some LNAPL exists today near MW2. TPH is the primary Site-related constituent detected in groundwater. VOCs were not generally used in the manufacturing processes at the Site, and there is no evidence that vapor degreasers were used by any operator on the Bronson Reel Site. Only one VOC (PCE) occurs at low concentrations in localized Site soil and in groundwater at the water table. The scattered, low detections of PCE in soil and its limited occurrence in groundwater indicate that use of this compound at the Site was limited.

Excavation activities from 1988 through 1990 removed the bulk of the source materials from the Site. As a result, the extent of metals at the facility is limited to soil around the periphery of the excavation that could not be removed because of the presence of the fence and buildings. The extent of TPH in soil is also limited to those peripheral areas, as well as to the vicinity of MW2 where soil has come in contact with LNAPL as the water table elevation has fluctuated over time.

6.2.2 Site Conditions Controlling Fate and Transport in Soil and Groundwater

Parts of the yard area are unpaved, which allows soil vapor to escape to the atmosphere and precipitation to penetrate the soil, which may have carried Site-related COCs to the shallow water table. However, the near-surface soil typically contains fine-grained materials providing sites for adsorption of COCs, and the soil pH is slightly alkaline, thereby limiting the mobility of metals.

In addition to the soil characteristics listed above, it is also worthwhile to consider additional site-specific information regarding the aquifer that was obtained during the SRI. Groundwater samples were analyzed in the field for indicator parameters including pH, temperature, specific conductivity, DO, ORP, and turbidity (Table 4-3). Nearly neutral pH values in groundwater (on average, about 7.3) were found consistently across the Site, indicating limited mobility of metals. The highest DO values occur at the water table and generally decrease with depth, indicating that oxygenated water from precipitation is recharging the aquifer. DO and ORP values in the shallow groundwater beneath the open yard area (west of the main building) are depressed relative to values measured at other locations, indicating possible localized reducing conditions. The effects on the fate of contaminants produced by this area of localized reducing conditions and other soil and groundwater conditions are discussed below.

6.2.3 Fate and Transport of PCE in Soil and Groundwater

Site soil contains scattered low concentrations (less than 35 μg/kg) of PCE at three locations. Shallow groundwater also contains PCE at low concentrations ranging from non-detect to 2.2 μg/L, all of which are below the EPA drinking water standard of 5 μg/L. PCE is the only VOC present in Site soil and groundwater for which there is no known upgradient source. Unlike the TCE that originates upgradient (east of the Site), PCE is present at much lower concentrations and only in shallow groundwater beneath the Site. The processes controlling PCE movement and attenuation at the Site are described below.

Transport of PCE in vadose zone soil occurs by dissolution into percolating water and subsequent movement to groundwater. The mobility of PCE is reduced, however, because it sorbs onto soil particles. The primary mechanism for attenuation of the limited PCE present in near surface soil is volatilization to the atmosphere and subsequent photodegradation.

PCE transport in groundwater is limited because concentrations are so low. A small reduction in concentration as a result of multiple attenuation processes produces non-detectable concentrations short distances from the minor scattered PCE detections on the Site. Attenuation processes that reduce concentrations of PCE in groundwater include volatilization, dispersion, adsorption, and biodegradation (reductive dehalogenation). PCE is not found in groundwater downgradient of the Site. Overall, it is apparent that the low concentrations of PCE in soil limit the concentrations of PCE reaching groundwater. Furthermore, the low concentrations of PCE in groundwater are rapidly attenuated to concentrations below detectable limits.

6.2.4 Fate and Transport of Inorganics in Soil and Groundwater

Five metals were detected in both soil and groundwater at higher concentrations than those found in samples collected east (upgradient) of the facility: arsenic, chromium, copper, nickel, and zinc. The extent of soil with elevated concentrations, however, is limited since all of the accessible soil within the fenced yard area has been removed. All that remains is a narrow strip near the fence line and building where the excavation could not advance. These remaining metals may have a small effect on groundwater quality immediately beneath the Site, because metals are observed in shallow groundwater at concentrations above upgradient concentrations. The effect is minimal, however, because concentrations of all metals in shallow groundwater at and downgradient of the facility are below MCLs. Elevated concentrations of some metals in deeper groundwater are not a result of Site activities.

Dissolution and sorption can affect metals concentrations in soil. Because some of the area around the periphery of the excavation is unpaved, precipitation can penetrate the soil and carry some compounds to the shallow water table. The near-surface soil at the Site typically contains fine-grained materials providing sites for adsorption of metals. Metals tend to be more readily adsorbed onto soil particles than either petroleum hydrocarbons or PCE and, thus, either move downward more slowly or become immobile. The tendency of metal cations to sorb to soil has been correlated with pH, oxidation-reduction (redox) potential, clay content, amount of organic matter, concentration of iron and manganese oxides, and calcium carbonate content. The generally neutral or slightly alkaline pH conditions of soil at the former Bronson Reel facility (ranging from 6.7 to 9.0 with an average of 8.1) limits the mobility of metals. Soil analytical results indicate that the mobility of metals was typically limited to the upper five feet of the soil column.

Movement of metals in groundwater is also greatly retarded by adsorption. As described previously, pH values in groundwater beneath the Site are nearly neutral (on average, about 7.3), indicating an environment that limits metals mobility (Table 4-3). Over time, changes in equilibrium conditions will allow periods of either adsorption or dissolution of metals in groundwater. As this process continues, metals will be slowly dissolved and attenuated by dilution in groundwater.

DO and ORP values in the uppermost groundwater beneath the yard area (west of the main building) are depressed relative to values measured at other locations, indicating possible localized reducing conditions. These reducing conditions may be expected to increase the solubility of metals. No elevated concentrations of metals (with the exception of manganese), however, were found in groundwater in this area. This is not surprising given the excavation and removal of soil from most of the yard area.

6.2.5 Fate and Transport of TPH and LNAPL in Site Soil and Groundwater

Petroleum hydrocarbons (TPH) are present in shallow groundwater at and near the facility. They also occur, to a limited extent, as LNAPL in MW2 in the southwestern portion of the Site. All accessible soil with higher TPH concentrations has been excavated at the site, so the mass of TPH in Site soil is limited. Hydrocarbons are present at low concentrations in deeper groundwater, but these detections are attributed either to off-property sources or sample contamination.

Sorption to soil particles, dissolution in infiltrating precipitation, and volatilization to the atmosphere are the primary mechanisms controlling TPH transport in Site soil. The lighter fraction of hydrocarbon compounds is particularly susceptible to volatilization and readily escapes to the atmosphere. TPH as LNAPL, occurring on top of the water table in the vicinity of MW2, rises and falls with changing water table elevations. These water table fluctuations (approximately three feet at the Site) smear the LNAPL within the vadose zone. As infiltrating recharge and groundwater move through the smear zone, the petroleum compounds are dissolved. Biodegradation and dissolution occur at the LNAPL/water interface, attenuating the concentrations of TPH over time.

Biodegradation of the petroleum hydrocarbons dissolved in groundwater beneath the Site may be a significant mechanism of attenuation. The rate of biodegradation is dependent on many factors, including temperature, moisture content, concentration of hydrocarbon, physical phase of the hydrocarbon (dissolved in water, dispersed as small globules, or as pure-product LNAPL), presence of acclimated microorganisms, availability of nutrients such as nitrates, and pH. Oxygen is often the rate-limiting nutrient for aerobic biodegradation, as may be true at this Site. DO and ORP values are depressed in the open yard area west of the main building, indicating that active biodegradation of petroleum hydrocarbons has been occurring in this area. In addition to biodegradation, volatilization of lighter-end hydrocarbons and sorption to aquifer materials contribute to TPH attenuation in groundwater. After a time, volatilization of the lighter hydrocarbon fraction leaves primarily long-chain (high molecular weight) compounds that tend to sorb to aquifer materials. Attenuation by these processes (biodegradation, volatilization, and sorption to aquifer materials) is the primary factor limiting downgradient movement of TPH at the Site.

6.2.6 Summary of Processes Affecting Site-Related COCs

Certain metals, petroleum hydrocarbons, and PCE have a suspected source relationship to historic operations conducted at the Site. A qualitative evaluation of the fate and transport processes that result in the attenuation of these contaminants indicates that the nature and concentration levels of these Site-related COCs prevent them from moving downgradient at high concentrations or for significant distances. In fact, PCE occurs below MCLs in groundwater beneath the Site and was not detected in groundwater downgradient of the Site. Effective past source removals ensure an ongoing decline in petroleum hydrocarbons through attenuation, as well as minimal movement of the low concentrations of metals still remaining on-Site. Petroleum hydrocarbons as LNAPL will be redistributed as the water table fluctuates. TPH in soil will dissolve in percolating precipitation, be carried to the water table, and then move slowly in groundwater. Movement of metals will be limited because sorption of these compounds to soil particles and aquifer materials tends to dominate over transport mechanisms.

During transport, Site-related COCs will naturally attenuate through various processes such as dilution, biodegradation, and volatilization. PCE is found at only low concentrations, and it will not travel far because the slightest attenuation reduces it to non-detectable concentrations. Metals will sorb to solids in the vadose and saturated zones and will slowly attenuate through dilution. Petroleum hydrocarbons in groundwater near the boundaries of the yard and at the fringes of the small LNAPL body near MW2 will be consumed during biodegradation.

In some cases, decreases in constituent concentrations will be gradual; in others, more rapid. Nevertheless, concentrations of Site-related COCs existing in soil and groundwater beneath the Site are expected to decline steadily in the future. Because the extent of Site-related COCs is limited, concentrations will eventually approach background levels.

7.0 STREAMLINED RISK ASSESSMENT

ITT conducted this SRA according to the requirements detailed in the AOC, SOW, and SRI/FFS Work Plan for the Site. A streamlined (focused) approach is considered appropriate, as indicated in these documents, because of the extensive removal activities already completed at the Site; therefore, the analysis presented is a screening-level risk assessment. If unacceptable risks had been identified during the screening process, a second phase of risk analysis would have been initiated to complete the Baseline Risk Assessment. Unacceptable risks have not been identified in this case; thus, an additional risk analysis is not required.

Although the risk assessment report is often submitted as a stand-alone document, it is incorporated into this SRI report in order to streamline the reporting process.[26] As a result, the risk reviewer/manager needs to review the previous sections of this report to obtain the background information that is required to evaluate this risk analysis. In the event the risk assessors cannot read the complete report, they should refer to the list below, as well as references given in the text, to find the pertinent background material.

Relevant Background Information for the Risk Reviewer	Report Section
Site History	Section 1
Land Use	Section 1
Site Geology and Hydrogeology	Section 3
Historic Data, SRI Data, and Data Quality	Section 4
Nature and Extent of COCs in Soil and Groundwater	Section 5

7.1 Objectives

The objectives of any SRA, according to EPA (1989a) are as follows:

- Provide an analysis of baseline risks to human health and the environment posed by remaining Site-related constituents in surface and subsurface soils and groundwater.

- Establish the concentration levels at which certain chemicals can remain on-site while ensuring adequate protection of human health and ecological receptors.

- Establish a basis for comparing the possible results of various remedial alternatives.

The screening portion of this SRA, presented below, will determine whether chemicals of potential concern (COPCs) to human health or chemicals of potential ecological concern (COPECs) exist at the Site and whether receptors may be exposed to those compounds. According to the AOC, SOW, and SRI/FFS Work Plan for the Site, the screening-level SRA will fulfill the requirements for the SRA if the evaluation determines either of the following:

- No remaining COPCs or COPECs related to Site activities are identified.

[26] Incorporation of a small risk assessment as a chapter in an RI report is an acceptable practice (EPA, 1989a).

- No complete exposure pathways exist for any identified COPCs and or COPECs.

If one or both of these conditions can be demonstrated, then no further risk evaluation is necessary for the Site. As shown in this section, the results of the SRA demonstrate that no unacceptable risk is posed to human health or the environment by remaining Site COPCs. The SRA process and results are summarized below.

7.2 SRA Process

Procedures followed in completing this SRA complied with provisions of the AOC, SOW, the SRA Phase I Work Plan (Appendix A in Earth Tech, 2003a), and current EPA risk assessment guidance. Guidance documents used included the following:

- Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A), Interim Final (EPA, 1989a).
- Standardized Planning, Reporting, and Review of Superfund Risk Assessments (Part D), Interim (EPA, 2001b).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, 1997).
- Guidelines for Ecological Risk Assessment (EPA, 1998); RAGS, Volume II, Environmental Evaluation Manual (EPA, 1989b).
- Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (EPA, 2001a).

In this analysis, the data are first evaluated for quality and relevance to the Site. The process then follows two separate paths: the first assesses risks to potential human receptors in the human health risk assessment (HHRA), and the second assesses risks to potential environmental receptors in the ecological risk assessment (ERA).

Typical screening-level HHRA and ERA analyses identify COPCs and COPECs based on a comparison of the maximum concentrations of detected substances to the lowest available regulatory values derived using numerous uncertainty and safety factors. This is a particularly conservative process because the screening values are determined using defaults assumed to represent maximum exposures to chemicals. For example, the values used to screen for COPCs take into account multiple exposure routes (i.e., ingestion, dermal contact, and inhalation of soils) over long exposure periods. Because these analyses are conservative, they often are refined in the Baseline Risk Assessment process to reflect more realistic exposure scenarios based on site-specific conditions. In this evaluation, the HHRA and ERA screening-level analyses for the former Bronson Reel facility are followed by weight-of-evidence evaluations that consider Site-specific conditions to determine whether final COPCs and COPECs exist at the Site.[27]

[27] At a minimum, the risk assessor should review the following material before proceeding: all of Section 1.0 Introduction, Section 2.2 Summary of Field Work, all of Section 4.0 Analytical Data, Section 5.0 Nature and Extent (introductory paragraphs), and all of Section 5.1 VOCs in Soil and Groundwater.

7.2.1 Data Compilation and Evaluation

Data used for conducting the SRA consisted of groundwater data from the SRI and soil data collected during both the SRI and past investigations. As stated in the AOC, SOW, and SRI/FFS Work Plan for the Site, chemicals originating from upgradient sources will not be considered during this SRA. Based on the nature and extent analyses presented in Section 5, the TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, 1,1,1-TCA, 1,1-DCE, and 1,1-DCA found in groundwater beneath the Site originate at upgradient sources.[28] All other VOCs in groundwater were evaluated in this SRA, as well as all metals and TPH. Soil data for VOCs, SVOCs, TPH, and metals were evaluated and used for this assessment, but data were not used from the soils that were previously excavated nor from historical samples for which depth, geographic location, or collection date were unknown. A list of the samples and analyses compiled for use in the SRA is presented in Tables 7-1 (soil data) and 7-2 (groundwater data).

Following the data compilation process described above, the analytical data were evaluated for relevance and quality by the following tasks:

- Sorting data into medium-specific exposure groups. The site-related exposure groups are surface soils (0 to 2 feet bgs), subsurface soils (2 to 10 feet bgs), shallow groundwater (water table to 12 feet bgs), and deeper groundwater (14 feet bgs to the base of the surficial aquifer);

- Defining data collected east of the facility as background soils data and upgradient groundwater data (see Section 4.0);

- Eliminating analytes not detected in any samples in a particular exposure group;

- Eliminating poor-quality data based on data qualifiers (in this case, no data were eliminated, but some data qualified with an L were considered as not detected);[29]

- Evaluating duplicate samples and retaining one result for the pair, either the result that is not qualified or the result with the highest concentration; and

- Defining the minimum and maximum concentration detected, range of reporting limits, and the location of maximum concentration.

Upon completion of the data compilation and evaluation process, the resulting data were used in two distinct procedures to select 1) COPCs for human receptors and 2) COPECs for ecological receptors. Each of these processes is described below, beginning with the HHRA.

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[28] The bases establishing that these compounds originate upgradient of the Site are presented in Section 5.1 VOCs in Soil and Groundwater and Section 6.1 Fate and Transport of Compounds Originating Off-Site.

[29] An L qualifier indicates that the analyte also was present in an associated blank sample at a concentration that was high enough to indicate the analyte may not be present in the sample; samples considered as not detected are highlighted in the analytical summary tables.

7.3 Human Health Risk Assessment

The HHRA evaluated the potential risk to human receptors that may be exposed to Site-related constituents. Preliminary COPCs were identified by comparing the maximum concentration of Site-related chemicals to screening criteria that are based on the lowest applicable regulatory values. Exposure pathways also were evaluated to determine if human receptors could be exposed to any preliminary COPCs under current and reasonable future land use conditions. Current conditions were considered to represent future conditions, a conservative basis that assumes no chemical attenuation over time. The overall screening-level approach is highly protective of human health. An additional weight-of-evidence analysis based on Site-specific conditions was conducted subsequently to determine final COPCs.

7.3.1 Identifying Preliminary COPCs

Site-related constituents were screened against several criteria to determine which compounds were present at concentrations that warranted further consideration in the HHRA. Compounds remaining after this initial screening were considered preliminary COPCs. Selection of a chemical as a preliminary COPC does not imply that it poses a health risk or contributes to a significant risk in an environmental medium. Preliminary COPCs, instead, are simply those compounds that require further analysis to evaluate their potential effects. The six steps taken to identify preliminary COPCs are outlined below.

Step 1: For each exposure group, Site-related constituents were eliminated if their maximum concentrations are less than the lowest of the risk-based screening levels. Citations for the regulatory criteria used to establish screening levels for each exposure group are given in Table 7-3.

Step 2: Essential human nutrients in groundwater (calcium, magnesium, potassium, and sodium) were eliminated if their maximum detected concentrations are lower than the estimated screening level calculated by dividing a nutrient benchmark (recommended dietary allowance or an estimated safe and adequate daily dietary intake) by a conservative ingestion rate (Table 7-4).

Step 3: Any naturally occurring inorganic analyte was eliminated if its maximum concentration is less than the screening level calculated from three times the mean of 1) the background concentrations for soils or 2) the upgradient concentrations for groundwater (Appendix A of Earth Tech, 2003a). These screening levels, referred to as background values, are presented in Tables 7-5 through 7-8 for surface soil, subsurface soil, shallow groundwater, and deeper groundwater, respectively.

Step 4: Any analyte previously eliminated was retained as a COPC if considerations such as mobility, bioaccumulation, persistence, and/or toxicity indicated that the chemical may present substantial risks in a given exposure group.

These characteristics were evaluated for the chemicals eliminated as COPCs based on the results of Steps 1 through 3. Regarding mobility, the chemicals eliminated in soil are not considered to be of concern for their migration potential to other media based on their relatively low concentrations in Site groundwater. Regarding bioaccum-ulation from soil or groundwater, this process is not a concern for the industrial land use scenario identified for the Site, which excludes ingestion of crops or livestock raised at the Site. Mercury is the only one of the eliminated chemicals identified by EPA as a priority Persistent, Bioaccumulative and Toxic chemical (EPA, 2004). Mercury was detected once in surface soil and once in deeper groundwater, at concentrations over two orders of magnitude less than the risk-based screening levels in soil and groundwater. Regarding toxicity, evaluation of this characteristic is inherent in the screening against toxicity-based screening levels, and the significance of a chemical's toxicity is reflected in the results of that screening. No previously-eliminated chemicals were retained for further analysis based on these considerations.

Step 5: Exposure groups were deleted if no COPCs remained for a particular group. Exposure groups were not dropped from the HHRA because preliminary COPCs remained in every group.

Step 6: Preliminary COPCs and exposure groups were defined after completion of Steps 1 through 5. The detected compounds evaluated to determine preliminary COPCs in each exposure group are presented in Tables 7-9 through 7-12 for surface soil, subsurface soil, shallow groundwater, and deeper groundwater, respectively. These tables list each constituent screened with its maximum and minimum concentrations, location of the maximum concentration, frequency of detection, range of reporting limits, background value, and screening value. Preliminary COPCs are identified, as well as the rationale for each selection.

The preliminary COPCs identified as a result of the above process are listed below for each exposure medium:

- Surface soils – carbon tetrachloride, chromium, copper, and TPH
- Subsurface soils – chromium and TPH
- Shallow groundwater – tin and TPH
- Deeper groundwater – TPH

7.3.2 Exposure Assessment

The exposure assessment evaluates potential pathways by which humans may be exposed to the preliminary COPCs and identifies complete pathways. A complete pathway includes a chemical source, a release mechanism, an exposure point where human contact with the affected medium occurs, and an intake route by which the chemical may enter the body. If any one of these elements is missing, the pathway is incomplete and is not considered further in the risk assessment. A preliminary CSM was developed to illustrate potential exposure pathways for the Site. The CSM is presented graphically in Figure 7-1; additional detail is presented in Table 7-13. Additional information regarding the Site setting is included in the initial paragraphs of Section 1.0 Introduction and in Section 1.3 Site Description and Background.

Land use at the Site is industrial and will remain so based on zoning. Industrial workers, therefore, have the greatest potential for exposure. The following exposure routes for COPCs at the Site are considered complete:

Exposure Routes	Current Industrial Receptor	Future Industrial Receptor
Ingestion of surface soil	X	X
Dermal absorption of surface soil	X	X
Inhalation of airborne particulates from surface soil	X	X
Inhalation of VOCs volatilizing from surface and subsurface soils to outdoor air	X	X
Inhalation of VOCs volatilizing from soils and shallow groundwater to indoor air	X	X
Dermal contact with subsurface soil and groundwater during excavation activities	---	X
Ingestion of groundwater	---	---

Note: An X indicates a complete exposure route; ---indicates an incomplete pathway.

The pathway for contact with groundwater currently is incomplete because groundwater is not used as a water source. As a result, this pathway is only included for a potential future scenario when a worker may come in contact with groundwater during excavation activities. Similarly, the pathway for ingestion of groundwater is not considered, as stated in the approved work plan documents listed in Table 2-1, because potable water is obtained from the municipal water supply, and a City of Bronson ordinance will restrict groundwater development and use in the NBIA. For the groundwater volatilization to indoor air pathway, only concentrations in shallow groundwater were screened based on recommendations in EPA's vapor intrusion guidance (EPA, 2002c). The results of the exposure assessment indicate that current or future industrial workers could be exposed to COPCs through the pathways and media identified above. As a result, all preliminary COPCs for each pathway are retained.

7.3.3 Uncertainty Analysis

The evaluation of chemical risks to human health is, by necessity, based on a number of assumptions with inherent uncertainties. As required in the work plan documents, this section identifies the uncertainties associated with key Site-related variables and major assumptions used in identifying COPCs.

The following sources of uncertainty are identified for screening-level risk analyses in general; their relevance to this screening-level SRA is also discussed briefly:

Limited subset of data: Sampling data are inevitably a subset of the data that could be collected and, as such, may not completely represent constituent levels. However, this is not a significant uncertainty factor for this SRA because of the large number of samples that have been collected and the fact that the sampling has been clustered where the highest chemical concentrations were anticipated.

Selection of COPCs: The investigation has targeted the appropriate analytes, and the SRI data has undergone data validation and QA/QC procedures, thus reducing potential uncertainties in defining COPCs. The use of historic data for soil concentrations, however, increases uncertainty in the HHRA. These data cannot be validated because field and laboratory QA/QC data are not available. Recent soil analyses for VOCs and some metals indicate that the early samples may be biased high, which would indicate that this SRA is conservative.

Relevance of background concentrations: If background concentrations are biased high, elimination of analytes by comparing them to background values may add uncertainty. For this SRA, use of Site-specific background and upgradient values that were collected at numerous locations reduces this uncertainty. A review of the background and upgradient samples reveals that concentrations of inorganics in the shallow groundwater sample collected from the water table to 12 feet bgs at ETBR3 may be unusually high. Only two analytes, however, were eliminated as preliminary COPCs based on comparison to the background value (which is calculated from the average of all eight upgradient samples); these compounds are lead and titanium. These constituents do not have health-based screening levels for the identified pathways (dermal contact or volatilization) and were only detected in shallow groundwater at estimated concentrations that were lower than the laboratory reporting limits. As such, no uncertainty has been introduced by comparing concentrations to background values that are calculated using the sample from ETBR3.

Lack of screening criteria: Chemical-specific, human health screening criteria have not been established for some analytes. The relevance of the lack of these criteria is discussed below for those specific COPCs.

Exposure point concentration: For the initial screening purposes, the exposure point concentration for each chemical was based on the maximum detected concentration in that exposure group. As discussed below, this overly conservative assumption significantly decreases any amount of uncertainty associated with this evaluation.

Calculation of screening levels: The level of uncertainty associated with the screening levels is reduced by using the most conservative screening values established for the identified exposure routes. In addition, the level of uncertainty is further reduced in the soils assessment by decreasing EPA's screening value by a factor of 10 to account for potential cumulative effects of multiple compounds.

In general, the level of uncertainty in this analysis is small because Site-specific conditions and the most conservative methods were used in each step of the process. The main uncertainty is associated with the use of historic soils analyses since the field and laboratory methods cannot be verified. Current attempts to duplicate previous results for VOCs and some metals, however, indicate that the earlier results may be biased high. As a result, uncertainty introduced by using the early results may identify more COPCs than would be identified if soils were re-sampled today using verifiable methods.

7.3.4 Identification of Final COPCs

The preliminary COPCs identified using the screening procedures were evaluated to determine whether these compounds qualify as final human health COPCs and, as such, represent a potential risk. As described above, a Site-specific, weight-of-evidence analysis is employed to make this determination. This analysis considers the applicability of the screening value, uncertainty in concentrations, location and frequency of detections, extent of measured concentrations, and relationship to background values.

One of the most important site-specific conditions that must be taken into account for the weight-of-evidence analysis is the major soil removal action that occurred from 1988 to 1990. During this time, soils covering 70 percent of the fenced portion of the Site were removed, generally down to the water table, and replaced with clean backfill. The maximum detected soil concentrations in the remaining 30 percent of the soils do not reasonably represent soil conditions at the former Bronson Reel facility. Furthermore, samples collected from the sidewalls and borings have focused on suspected source areas and, thus, represent the highest concentrations in the remaining soil.

A more representative concentration for Site soil is calculated using a weighted average. In this calculation, the mean concentration of the undisturbed soil (outside the excavated area) is multiplied by 30% because this soil represents approximately 30% of the surficial soil volume at the Site. The clean backfill (using the mean background concentration as a surrogate) is multiplied by 70% because this soil represents approximately 70% of the surficial soil volume at the Site. The weighted average is calculated as follows:

$$C_{wt\text{-}avg} = 0.3C_{mean} + 0.7C_{bgrd}$$

where:

$C_{wt\text{-}avg}$ = weighted-average concentration (μg/kg)

C_{mean} = mean concentration of detections outside the excavated area; non-detects at one-half the reporting limit (μg/kg)

C_{bgrd} = constituent- and media-specific background concentration (μg/kg)

The weighted-average concentration represents the potential exposure conditions for the industrial worker more accurately than either the simple average of the detected concentrations or the maximum concentration. Weighted average calculations for preliminary COPCs are provided in Table 7-14.

The identified preliminary COPCs are carbon tetrachloride (surface soils), chromium (surface and subsurface soils), copper (surface soils), tin (shallow groundwater), and TPH (surface and subsurface soils and shallow and deep groundwater). Tin and TPH are included in the list of COPCs only because screening levels have not been established for these compounds. The lack of established EPA or MDEQ risk-based screening values for the exposure pathways identified at the Site indicates that these substances are not considered compounds of significant concern for those exposure routes. Nevertheless, in keeping with the conservative nature of the risk assessment process, these compounds are evaluated and discussed below with the other COPCs.

Carbon tetrachloride was detected in only one of the 15 surface soil samples, at a concentration of 91 μg/kg at sample B-12 (0-2 feet). The detection was in an historic soil sample from 1990, and no QA/QC documentation is available for this sample. Carbon tetrachloride was not present in any samples collected during the recent SRI. The most conservative screening level for this compound is 55 μg/kg, which is protective of the industrial worker potentially exposed to direct contact with soil. This number is based on EPA's preliminary remediation goal (PRG) of 550 μg/kg, which is calculated using a carcinogenic risk level of 10^{-5}.[30] The screening level of 55 μg/kg was determined using an even more conservative level of 10^{-7}, which accounts for potential cumulative affects

[30] EPA Guidance defines an acceptable carcinogenic risk between 10^{-4} and 10^{-6}.

of multiple compounds.[31] Considering the very limited number of COPCs and the extensive soil excavation that has removed most of the soils, it is clear that this more conservative screening level is not appropriate. The detected concentration of 91 µg/kg is below all of the screening criteria defined for other exposure routes in this SRA. Carbon tetrachloride is highly volatile (vapor pressure of 91.3 millimeters of mercury at 20 degrees Centigrade) and evaporates rapidly from soil (Howard, 1990). As a result, it is certain that this concentration would no longer be present in surface soils because the sample was collected over 14 years ago. Based on this weight-of-evidence evaluation, carbon tetrachloride is not identified as a final COPC in surface soil.

Chromium (total) concentrations from historic sampling events exceeded screening levels in five of 19 surface soil samples and six of 35 subsurface soil samples. The highest concentration in both surface and subsurface soils is 280,000 µg/kg. The screening level for total chromium is based on EPA's PRG of 448,320 µg/kg which, as described above, was subsequently reduced to the highly conservative number of 44,832 µg/kg based on the carcinogenic risk level of 10^{-7} to account for potential cumulative affects of multiple compounds. The PRG screening value is calculated assuming $1/7^{th}$ of the total chromium is hexavalent chromium, which poses more risk to human health than other forms of chromium.

As described in Section 5, an additional six samples were subsequently collected in June 2004 outside the excavated area at the three locations with the highest historic concentrations of total chromium to determine whether hexavalent chromium is present at concentrations of concern. Results of the Phase III SRI samples demonstrate that the concentrations observed in the historic data could not be replicated in samples collected as close as possible to the original locations. Total chromium concentrations detected in the recent samples range from 5,850 to 29,900 µg/kg, or about one-third to less than one-twentieth of the historic values. The inability to duplicate the higher concentrations found previously is evidence that soils with higher concentrations are extremely limited at the Site. It may also show that the recent, verifiable analyses are more accurate than the historic analyses and, thus, concentrations are lower than the original analyses indicated. Hexavalent chromium was present in these six SRI samples at concentrations ranging from 252 to 2,550 µg/kg. Both total and hexavalent chromium are well below their respective screening levels in all of the recent samples (EPA's PRG for hexavalent chromium using the more conservative 10^{-7} risk factor is 6,400 µg/kg).

Average concentrations of total chromium calculated using historic and recent data are 43,630 µg/kg in surface soils and 33,433 µg/kg in subsurface soils. Weighted-average concentrations for total chromium are 21,148 µg/kg in surface soils and 16,094 µg/kg in subsurface soils. Both the average and weighted-average concentrations are below the lowest chromium screening value of 44,832 µg/kg for surface and subsurface soils. Therefore, based on the discussion above, it is unreasonable to define total chromium as a final COPC based on a risk factor calculated for hexavalent chromium, when it is clear that hexavalent chromium is not present at concentrations of concern at the former Bronson Reel facility. As a result, total chromium is not identified as a final COPC for either surface or subsurface soils.

[31] This conservative carcinogenic risk level was adopted in the Revised SRI/FFS Work Plan (2003a) in accordance with EPA comments dated 2/21/03 on the Draft Work Plan.

Copper exceeds the most conservative screening level for only a single detection in surface soil. At MW4, located just north of the property in the railroad right of way, copper was present in surface soils at 4,400,000 µg/kg, which exceeds the screening level of 4,087,666 µg/kg. This screening level is considered protective of the industrial worker potentially exposed to direct contact with soil. Similar to the other compounds, this screening value also has been reduced from EPA's PRG value of 40,876,660 µg/kg by a conservative factor of 10 to account for the additive effects of exposure to multiple compounds. The average of all concentrations is 280,105 µg/kg; the weighted-average concentration is 108,345 µg/kg. Both of these values are well below the lowest screening value for copper of 4,087,666 µg/kg. As a result, copper is not identified as a final COPC in surface soil.

Tin was identified as a COPC in shallow groundwater for two reasons. The first is because a screening value has not been defined by EPA or MDEQ for the pertinent exposure routes identified at the Site, indicating that tin is not a significant concern for the identified exposure pathways. The second reason tin remains a COPC is that a background concentration could not be determined for shallow groundwater because the associated blanks for all of the background samples contained tin. In groundwater beneath and immediately downgradient of the facility, tin was present in only two of 18 shallow groundwater samples at the estimated concentrations of 1.76J and 0.998J µg/L.[32] Both detected concentrations are below the reporting limit of 5 µg/L. Furthermore, the maximum concentration of tin in shallow groundwater is orders of magnitude below the conservative screening criteria for tin used by EPA Regions 3 and 9 of 2,190 µg/L. This concentration is considered protective of drinking water, which is not a valid pathway for this Site. Considering this evidence, tin is not identified as a final COPC in shallow groundwater.

TPH was identified as a COPC in all media only because no screening values exist for TPH. The presence of TPH in soils and groundwater beneath the facility is not unexpected, given the presence of LNAPL in the vicinity of MW2. Retention of TPH as a COPC, however, is not reasonable because there are no risk-based screening levels for TPH. Surrogate compounds were reviewed to evaluate the potential risk associated with the TPH at the former Bronson Reel facility. BTEX compounds, which represent the highest risk from petroleum hydrocarbons, are present in soil only at concentrations well below screening levels. Toluene is the only surrogate compound detected in groundwater beneath the Site, and it was only present at estimated concentrations below the reporting limit of 1.0 µg/L. These concentrations are well below groundwater screening levels. TPH is not a federally regulated substance and does not have an applicable screening level. As a result of these factors, TPH is not identified as a final COPC in Site media.

7.3.5 Summary of the Screening-Level HHRA

In summary, the few constituents initially identified as COPCs in surface or subsurface soils or in shallow or deep groundwater are not defined as final COPCs following the reasonable, Site-specific, weight-of-evidence analyses presented above. Although this type of evaluation is usually performed as a later step in a Baseline Risk Assessment, it is appropriate to conduct a weight-of-evidence analysis immediately following this

[32] As with the background samples, tin was also reported present in other shallow groundwater samples at low, estimated concentrations below the reporting limit, but these concentrations were considered as non-detects based on the presence of tin in associated blanks.

screening level SRA because of the enormous amount of removal work that has already been conducted at the facility (over 10,000 cubic yards of soils have been excavated from this 1.85-acre property). Furthermore, the effort, time, and cost to conduct the next steps in a full Baseline Risk Assessment are unreasonable, especially since these few COPCs, if not eliminated in one of the next steps in the risk assessment, will certainly be eliminated ultimately using similar weight-of-evidence analyses. It is clear that the compounds discussed above do not present an unacceptable risk to human health and no further evaluation of risk should be conducted.

7.4 Ecological Risk Assessment – Preliminary Risk Evaluation

The ERA component of the SRA determines whether remaining Site-related chemicals have the potential to cause adverse effects on ecological populations. EPA guidance defines an eight-step process for ERAs. The first two steps of the process provide a preliminary risk evaluation (PRE) that identifies preliminary COPECs and potentially complete exposure pathways. Initial screening is accomplished in the ecological PRE by comparing maximum detected constituent concentrations in Site media to risk-based screening levels (i.e., medium- and chemical-specific ecological screening values [ESVs]). Chemicals in environmental media that pose no risk to ecological receptors are eliminated, and any chemicals that potentially pose a risk are retained for further evaluation.

In accordance with the AOC, SOW, and NBFF OU1 Work Plan, the PRE for this SRI/SRA includes the first two steps of an ERA, as well as an uncertainty analysis and a Scientific/Management Decision Point (SMDP) evaluation, as outlined below:

Problem Formulation and Effects Evaluation (ERA Step 1)

- Problem Formulation: characterization of the Site's ecological setting and development of a conceptual site model,
- Effects Evaluation: identification of ESVs,

Screening-Level Exposure Estimate and Risk Calculation (ERA Step 2)

- Exposure Estimate: determination of Site-related concentrations,
- Risk Calculation: comparison of Site-related compounds to ESVs to identify preliminary COPECs,

Uncertainty Analysis

SMDP

This process is designed to be a conservative screening-level evaluation; thus, if the assessment indicates there is no ecological risk, a high degree of certainty can be associated with that conclusion. On the other hand, if preliminary COPECs are identified, it is reasonable to conduct a weight-of-evidence evaluation that considers Site-specific conditions to determine whether the ERA needs to continue past the PRE. Although this evaluation is usually performed later in the risk assessment process, it is an appropriate step as part of the initial SMDP in this case because the potential exposure for any ecologic receptor is limited since all accessible soils already have been removed from the Site.

7.4.1 Problem Formulation and Effects Evaluation (ERA Step 1)

The first step of the ERA, to define the ecologic setting and identify appropriate screening values, is described in the following two sections.

7.4.1.1 Problem Formulation - Characterization of Ecological Setting and Development of CSM

The ecological setting consists of the terrestrial environment on and in close proximity to the former Bronson Reel facility. The Site is zoned industrial and has been used for industrial purposes since 1929 (Site photographs are included in Appendix A). The Site has been vacant since the middle 1990s, but recently has been leased by the current property owner to store construction equipment. The surrounding areas are mixed industrial and residential and are included in an area defined by the City of Bronson as the NBIA Superfund Site. The former Bronson Reel facility and surrounding area offer limited, low-quality terrestrial habitat.

Over half of the property is covered by the facility building (Figure 1-4). The western-portion of the property is enclosed by a fence. The fenced area includes two storage sheds at the northern end. The center portion of the yard area is paved with asphalt to provide a wide driveway from North Ruggles Street to the building. Flora at the Site is scattered between the buildings and adjacent to streets in small, open, vegetated areas. Small portions of the areas along streets are covered by mowed grass. Other areas, such as the areas along the north and west perimeters of the property and within the fence, are covered by unmowed grasses, forbs (broadleaf plants and weeds), and shrubs. This early successional community is ruderal (growing where the natural vegetation cover has been disturbed by humans) and dominant on the Site because the facility is no longer being actively maintained by the current owner.

No water bodies are present within or near the boundaries of the Site. The closest water bodies are man-made features which consist of the western lagoons (located approximately 1,200 feet north of the Site) and a man-made drainage canal known as CD30 located north of the NBIA. A concrete basin exists adjacent to the main building to prevent storm water runoff from the roof from entering the building. A sump located on the northeast corner of this basin apparently is not operational because the basin periodically contains standing water. A small colony of cattails has developed at the waterline and algae appear near the center of the standing water.

Habitat for animals is limited in the industrial areas at and adjacent to the facility (see Site photographs in Appendix A). Birds may forage in the area, but their use of the Site would likely be minimal because of its small area (1.85 acres total including a 43,500 square-foot former manufacturing building and one 2,600 square-foot outlying building), a vegetative community with limited structure and diversity, and the potential for disturbance in an industrialized area. Use of this Site by mammals is most likely limited to small species, such as rodents. The facility is surrounded by a locked chain-link fence, impeding access by larger species. The man-made storm water basin on the west side of the building contains water only intermittently and, therefore, does not support obligate aquatic animals.[33] Based on the limited areas of vegetation on the Site, the dominance of ruderal vegetation, and the long period of industrial land use on the Site and in the vicinity, this facility and its immediate surroundings do not provide significant habitat for animals.

Information regarding endangered, threatened, and special concern (ETS) species was obtained from a review of a recent search of the Michigan Natural Features Inventory (MNFI) database for occurrences of ETS species in Branch County and the St. Joseph River Watershed (MNFI, 2004). The MNFI list incorporates both federal and state listed species. Only one ETS plant species (a flower that prefers prairie habitat) and three ETS animal taxa (two reptiles and one amphibian that require water habitats) have been recorded as occurring in Branch County (Table 7-15). There are no records of the occurrence of any ETS taxa in the vicinity of the Site. The habitats preferred by the four listed species do not occur at the Site and are substantially different from those that do occur. Accordingly, neither these four nor other ETS species likely occur at the Site.

A preliminary CSM was developed to evaluate the potential chemical movement and exposure pathways through which ecological receptors may be exposed to Site-related constituents remaining at the Site. This preliminary CSM is illustrated in Figure 7-1. Under both current and reasonably anticipated future land use scenarios for the Site, terrestrial ecological receptors may be exposed to COPECs in surface soil through complete exposure pathways involving inhalation of dust or vapor, ingestion of soil, and dermal contact with soil, and via the food chain. The inhalation and dermal contact pathways, however, are difficult to estimate and minimal compared to ingestion. As a result, only incidental and food-chain ingestion pathways will be evaluated. Because there are no nearby surface water bodies, there is no potential for exposure of terrestrial or aquatic receptors to storm water runoff or groundwater discharge.[34] Therefore, as described in the SRA Phase I Work Plan (Appendix A of Earth Tech, 2003a), the only pathway considered complete in the ERA component of the SRA is direct ingestion of Site-related constituents in soil.

7.4.1.2 Effects Evaluation - Identification of ESVs

The medium- and chemical-specific ESVs used in this screening-level evaluation are EPA Region 5 Ecological Screening Levels (ESLs) (EPA, 2003). For each chemical included in the ESL database (RCRA Appendix IX Hazardous Constituents), the lowest receptor-specific ESL for plants, invertebrates, or mammals was selected as the soil ESL (EPA, 2003). Thus, the screening levels used in this evaluation are quite conservative and, thereby, will protect a wide range of receptors that potentially could be exposed to Site soil.

[33] The concrete basin is 78 feet long by 26 feet wide. It slopes away from the building where it is shallowest and often dry to a depth of up to 1.5 to 2 feet at the western edge. It is possible that storm water collecting in this basin may be used by semi-aquatic animals, such as amphibians, but such use would only be temporary.
[34] Shallow groundwater may periodically discharge to CD30 approximately 1,300 feet north of the Site. However, the potential for Site-related constituents to travel this distance at significant concentrations is minimal.

7.4.2 Screening-Level Exposure Estimation and Risk Calculation (ERA Step 2)

The second step of the ERA consists of selecting the analytical results that represent the appropriate exposure pathway(s) and comparing those results to the screening values. These two processes are described in the following two sections.

7.4.2.1 Exposure Estimate - Determination of Site-Related COC Concentrations

Analytical data used in the ecological PRE consist of surficial soil chemistry results for the Site and adjacent background locations, as presented previously in the Data Compilation and Data Evaluation subsections near the beginning of Section 7.0. The screening-level exposure estimate was defined as the maximum chemical concentration in remaining Site surface soil for each detected analyte. This estimate provides a highly protective basis for estimating the exposure of ecological receptors to Site soils. As specified in the approved work plan, pathways for exposure of ecological receptors to subsurface soils are incomplete and consequently were not evaluated in this SRA

7.4.2.2 Risk Calculation - Comparison of Site-related COCs to ESVs

In this step, the Site soil concentrations were compared to the ESVs and background concentrations to establish preliminary COPECs. This analysis is presented in Table 7-16. Preliminary COPECs were determined by dividing the maximum detected concentration of each analyte in surface soil by the appropriate chemical-specific ESV to produce a preliminary hazard quotient (HQ). Chemicals with an HQ less than or equal to 1.0 were considered unlikely to have adverse effects on ecological receptors and were eliminated from further evaluation in the ecological PRE. Compounds with an HQ greater than 1.0 were identified as preliminary COPECs. Compounds without an ESV also were identified as preliminary COPECs and were retained for further evaluation using other lines of evidence such as surrogate compounds to characterize the potential risk associated with these compounds. In accordance with the work plan, inorganic chemicals were also compared to their respective Site-specific background value, which was calculated by multiplying the mean background concentration by three. If the maximum detected concentration was less than the background screening value, the compound was eliminated from further evaluation, even if the HQ value was greater than 1.0. Compounds identified as preliminary COPECs in Site surface soil included three SVOCs (bis-2-ethylhexylphthalate, butylbenzylphthalate, and di-n-butylphthalate), seven inorganics (cadmium, chromium, copper, lead, mercury, nickel, and zinc), and petroleum hydrocarbons (Table 7-16).

7.4.3 Uncertainty Analysis

Some uncertainty is inherent in each step of the ERA process. In general, the major factors contributing to uncertainty in this ecological PRE tended to overestimate the risk to receptors. These overestimates occurred for the following reasons:

- *Maximum concentrations:* The potential risk is overestimated because the maximum concentrations of analytes were compared to ESVs. This approach assumes receptors are continuously exposed to the maximum concentrations in surface soil. Clearly this is unlikely considering the extensive excavation that has been conducted at the Site.

- *Data represent highest concentrations:* Analytical data used in the PRE were collected from investigations that focused on potential source areas where elevated concentrations are most likely to occur. Concentrations measured at these locations were assumed to be representative of concentrations in surface soils throughout the exposure area evaluated. Again, this is overly conservative considering that over 70 percent of the yard soils have been removed.

- *Conservative ESVs:* Toxicity values (ESVs) used in the PRE screening are not Site-specific and were derived to be highly protective of all species. Furthermore, most toxicity studies on which the ESVs are based administered the chemical under study in a highly bioavailable form. This does not represent actual Site conditions, because Site concentrations included all forms of a given chemical, not just the highly bioavailable form.

- *Lack of screening values:* Some uncertainty is introduced because ESVs have not been established for some chemicals detected at the Site. Nevertheless, these chemicals were evaluated using other lines of evidence, such as surrogate compounds, to infer whether they may pose a risk. This weight-of-evidence evaluation reduced uncertainty in the characterization of risk.

- *Use of historic soil analyses:* Historic soils analyses cannot be verified because of the lack of field and laboratory QA/QC information. Recent attempts during the SRI to duplicate previous results for VOCs and some metals, however, indicate that the earlier results may be biased high and the uncertainty introduced by using the early results may identify more COPECs than would be identified if soils were re-sampled today using verifiable methods.

Because the most conservative methods were used in each step of the process, the PRE is overly conservative. As a result, a few preliminary COPECs are identified in the PRE. The preliminary COPECs can be assigned to three categories: SVOCs, TPH, and metals.

7.4.4 Scientific/Management Decision Point

According to EPA guidelines (EPA, 1997), it is at this decision point that the risk assessor determines whether there is justification to continue to the next step of the ERA process based on the identification of preliminary COPECs and potentially complete exposure pathways. The findings of the PRE are used to determine whether Site-related constituents pose negligible ecological risk (thereby providing a basis for recommending no further action at the Site) or have the potential to pose significant ecological risk (thereby providing a basis for recommending an remedial or interim action, additional field study, and/or continuation of the ERA).

The COPECs identified using the screening procedures above were evaluated to determine whether these compounds qualify as COPECs and, as such, represent an unacceptable ecological risk. A Site-specific, weight-of-evidence analysis is employed to make this determination. This analysis considers the applicability of the screening value, uncertainty in concentrations, location and frequency of detections, extent of measured concentrations, and relationship to background values.

As discussed earlier, in Section 7.3.4, a weight-of-evidence evaluation is particularly applicable for the former Bronson Reel facility because the accessible Site soils have already been removed. Approximately 70 percent of the exposed soils within the facility's fence were removed, down to the water table in most areas. The maximum detected soil concentrations in the remaining 30 percent of the soils do not reasonably represent soil conditions at the former Bronson Reel facility. The weighted-average concentration represents potential exposure conditions for the ecological receptor more accurately than either the simple average of the detected concentrations or the maximum concentration. Refer to Section 7.3.4 for an explanation of the weighted average calculation. Weighted average calculations for preliminary COPECs are provided in Table 7-14.

The preliminary COPECs identified in surface soils are three SVOCs (bis-2-ethylhexylphthalate, butylbenzylphthalate, and di-n-butylphthalate), TPH, and seven inorganics (cadmium, chromium, copper, lead, mercury, nickel, and zinc). The three SVOCs detected in Site soils in 1989 are all phthalate esters considered by EPA to be common laboratory contaminants (EPA, 1989a). TPH is included only because there is no screening value for petroleum hydrocarbons; the lack of a screening value indicates it is not considered a significant concern to regulatory agencies. The ESVs for inorganic compounds are extremely low; in fact all of the ESVs are lower than the background value concentrations for metals except for mercury. To further illustrate the conservative nature of the ESVs, the concentrations found in every background surficial soil sample (two of which [ETBR19 and ETBR20] were collected from the yards of adjacent residences) was above the ESV for cadmium, chromium, copper, lead, and zinc. This indicates soils from residential yards would be considered COPECs for these analytes.

It is likely that all of the compounds identified in this PRE step would be eliminated in the next step of an ecological risk assessment (the problem formulation of a Baseline Risk Assessment). This is particularly true given the limited acceptable habitat for ecological receptors. Nevertheless, a site-specific, weight-of-evidence evaluation for each of these preliminary COPECs is presented below to provide additional justification for the elimination of these constituents from the ERA process.

Phthalate esters, bis-2-ethylhexylphthalate, butylbenzylphthalate, and di-n-butylphthalate, are identified as preliminary COPECs. EPA guidance, however, identifies these compounds as common laboratory contaminants. As such, these phthalates are not considered Site-related compounds. Furthermore, phthalates are biodegraded rapidly by microorganisms in soil; for example, one study found that di-n-butylphthalate was completely degraded under both aerobic and anaerobic conditions within 100 days (Agency for Toxic Substances and Disease Registry, 2001). Thus, even if the phthalate esters were present at the time of sampling in 1989, it is probable that after 15 years, these compounds do not exceed ESVs. Considering these factors and that this area provides limited habitat for ecological receptors, these three phthalates are not considered final COPECs at the Site.

TPH was identified as a preliminary COPEC only because no ESV has been established for petroleum hydrocarbons. Although lacking a screening value, the potential risk from petroleum hydrocarbons can be evaluated using surrogate analytes (BTEX compounds). The BTEX compounds evaluated had HQs significantly lower than 1 (Table 7-16). The highest HQ for any of these compounds was 0.10 for benzene, which was calculated by dividing the maximum concentration of 26 μg/kg found in a soil sample collected in 1989 by its ESV of 255. This clearly indicates that petroleum hydrocarbons in surface soil do not pose an unacceptable risk. Accordingly, petroleum hydrocarbons are not considered a final COPEC at the Site.

Mercury was identified as a preliminary COPEC based on a single detection of 130 µg/kg in soils from the southern wall of the excavation. The ESV for mercury is 100 µg/kg, resulting in a HQ value of 1.3 for mercury. Mercury was not present in the other two Site soil samples that were analyzed for mercury. As a result, the average concentration of mercury is 77 µg/kg, and the weighted-average concentration is 37 µg/kg, both of which are below the lowest screening value for mercury of 100 µg/kg. Accordingly, mercury is not considered a final COPEC at the Site.

Other metals identified as preliminary COPECs are cadmium, total chromium, copper, lead, nickel, and zinc. These six inorganic compounds have HQs that are higher than 1; the HQs range from 52 for nickel up to 3352 for lead. As discussed earlier, this is not unexpected because the ESVs for metals are so low that most background samples exceed the screening values. Therefore, in order to evaluate whether these compounds represent an unacceptable potential ecological risk, the concentrations of these metals are compared to the background values for surficial soils.[35] For all of these compounds, the maximum concentration exceeds the background value. The maximum concentration, however, is not representative of the concentration that a potential ecologic receptor would be exposed to, especially given that the accessible soils have been removed at this Site. The weighted-average concentration, calculated for each of these constituents, more closely represents the potential exposure concentration. The weighted-average concentrations for cadmium (221 µg/kg), total chromium (21,148 µg/kg), lead (32,463 µg/kg), nickel (28,140 µg/kg), and zinc (106,264 µg/kg) all are below their respective background values. Thus, these metals are not considered final COPECs at the Site. The weighted-average concentration for copper (108,345 µg/kg) exceeds its background value because of an anomalously high value for a sample collected in 1989 at the off-Site location in the railroad right of way at MW4. Elimination of this one off-Site sample from this analysis results in a weighted-average concentration for copper of 39,680 µg/kg, which is below the background level. Because the anomalously high value was collected off-Site, copper is not considered a final COPEC for the Site.

7.4.5 Summary of the Screening-Level ERA

As a result of the site-specific, weight-of-evidence evaluation presented above, none of the preliminary COPECs are identified as final COPECs for the Site. The Site is an industrial area that provides only a small area of habitat in which potential receptors may forage. Furthermore, the habitat is low in both the quality and diversity of forage and shelter it offers. Based on the poor quality habitat and because there is no significant ecological risk at the Site, the ERA process should not continue past this point.

7.5 SRA Conclusions

The SRA conducted for the former Bronson Reel facility utilized data from recent and historic investigations to evaluate the potential risks posed by Site-related compounds to human and ecological receptors. Potential exposure pathways were thoroughly evaluated to determine if it is, or may become, possible for receptors to be exposed to Site-related

[35] The background values are calculated by multiplying the mean background concentration by three as shown in Table 7-5.

chemicals. Maximum detected concentrations were screened against the lowest available regulatory criteria to identify preliminary COPCs and COPECs. These preliminary compounds were further evaluated using additional lines of evidence based on Site-specific conditions. Because most accessible Site soils have been removed, this additional evaluation provides a rational basis for determining final COPCs and COPECs. The screening approach is conservative in that it eliminates only compounds that clearly do not pose an unacceptable potential risk to human or ecological receptors.

The results of the SRA demonstrate that the Site poses no unacceptable potential risk to human or ecological receptors. Several factors support this conclusion:

- Exposure to groundwater for drinking water will not occur because the City of Bronson will be enacting an ordinance restricting the use of groundwater.
- Current land use at the Site is industrial and will remain as such in the future based on zoning. Only industrial workers have the potential to be exposed to Site soils.
- No final COPCs were identified for either surface or subsurface soil or for shallow or deep groundwater following the preliminary COPC screening and the weight-of-evidence analysis.
- No unacceptable potential risk to human health occurs as a result of COPCs remaining on Site.
- The habitat is not suitable for any of the four known threatened or endangered species found in the county that prefer wetland or prairie habitats.
- Site habitat is not favorable because access to the Site is limited and it offers only limited forage species and shelter.
- No final COPECs were identified for surficial soils at the Site.
- No unacceptable potential ecological risk occurs as a result of compounds in surficial soils at the Site.

In conclusion, no unacceptable potential risks to human health or ecological receptors were identified in the SRA; thus, no further evaluation of risks is necessary for the Site. The SRA, therefore, satisfactorily meets the requirements for the risk assessment as set out in the AOC and SOW.

8.0 RECOMMENDATIONS

The Site-related COCs, with the possible exception of TPH, exist at such low concentrations that no groundwater plume originates at the Site. The risk assessment indicates that Site-related COCs do not pose an unacceptable potential risk to human health, the environment, or ecological receptors provided that the property continues to be zoned for industrial use. Therefore, a FFS should be prepared which evaluates a no further action remedy and the institutional controls that may be necessary for ongoing protection of human health and the environment. Any concerns regarding residual TPH at the facility should be addressed separately with the current property owner under Michigan's Part 201, M.C.L. 324.20101 *et seq.*, outside of the Superfund process.

9.0 CONCLUSIONS

The conclusions of the SRI/SRA for the former Bronson Reel facility are as follows:

1. Remedial work completed by Kuhlman Corporation/Bronson Specialties Inc. from 1989 to 1990 included the removal of 70 percent of the exposed Site soils, generally down to the water table. The purpose of these excavations was to remove oil-stained soils and soils with metal concentrations above background levels.
2. Prior to excavation, soils at six boring locations were screened using an OVA, and on the basis of the screening four samples were selected for VOC analysis. TCE was not detected in any of these samples.
3. Following the excavation, forty-one soil samples were collected from the excavation sidewalls and from borings installed outside of the excavation. Of these forty-one samples, TCE was detected at low concentrations (60 µg/kg and 110 µg/kg) in only two samples.[36]
4. There is no indication that degreasers were used in Bronson Reel operations based on available historic operational information.
5. The maximum concentration of TCE detected in on-site soils during this SRI (conducted in 2003 and 2004) is 2.6 µg/kg.
6. TCE is not detected in oil or groundwater collected from MW2 in the vicinity of the former chip bins.
7. Extensive investigation of the Site and areas near the Site during the SRI has demonstrated TCE concentrations detected in groundwater beneath the Site are part of a regional groundwater plume migrating beneath the Site from a source or sources located to the east.
8. The areal distribution of TCE and TCE degradation products at and near the Site indicates that the dominant groundwater flow direction is to the west-northwest toward CD30, although flow is sometimes to the west or southwest when the water table is low.
9. Completion of the SRA using conservative risk-based screening values for industrial land use and subsequent weight-of-evidence analyses shows that site-related contaminants pose no unacceptable potential risk to human health or the environment.
10. A FFS should be prepared which evaluates a no further action remedy and a remedy consisting of institutional controls only.

[36] For comparison, the current Michigan Soil Cleanup Criteria that is protective of residential drinking water is 100 µg/kg.

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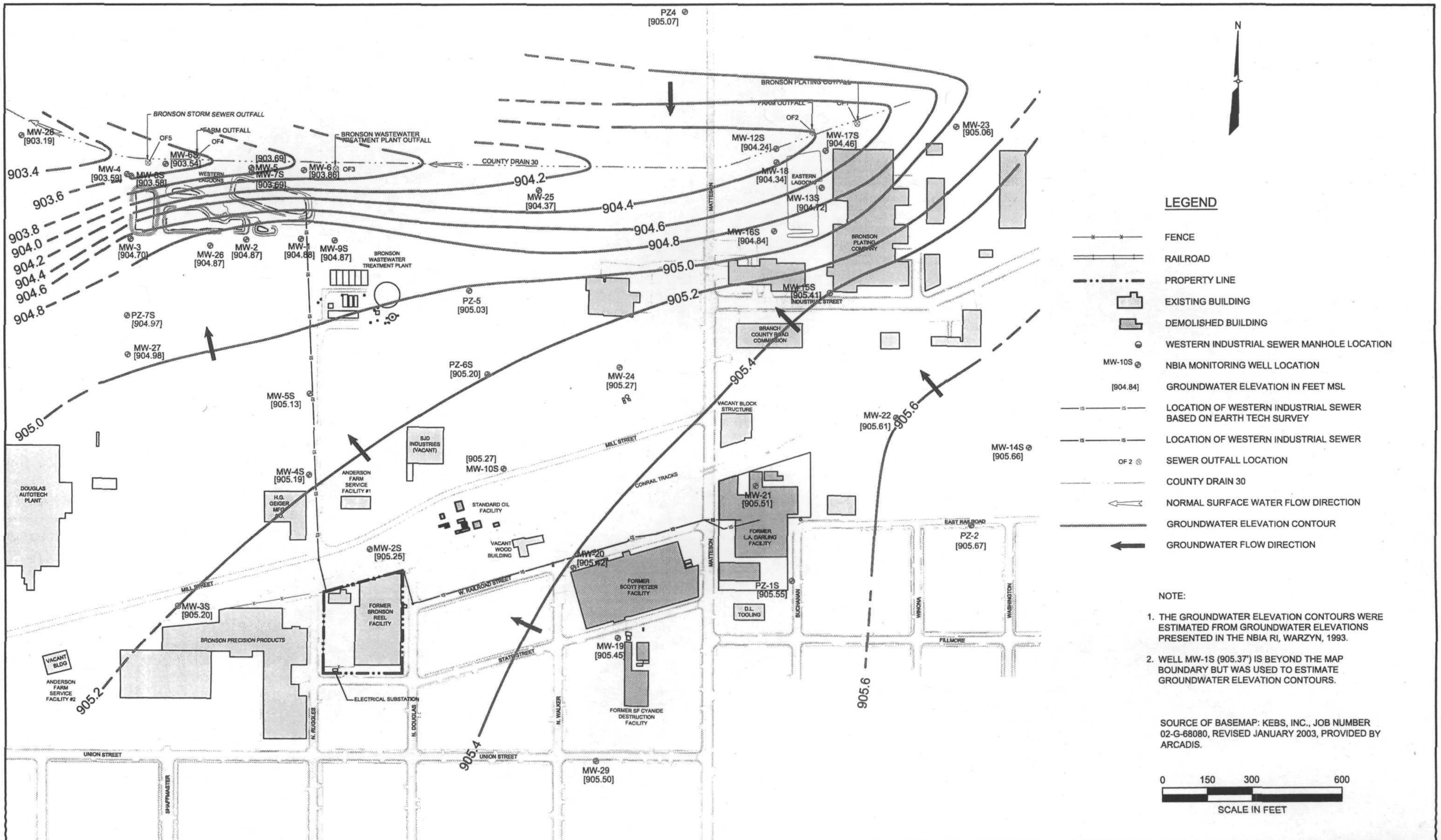
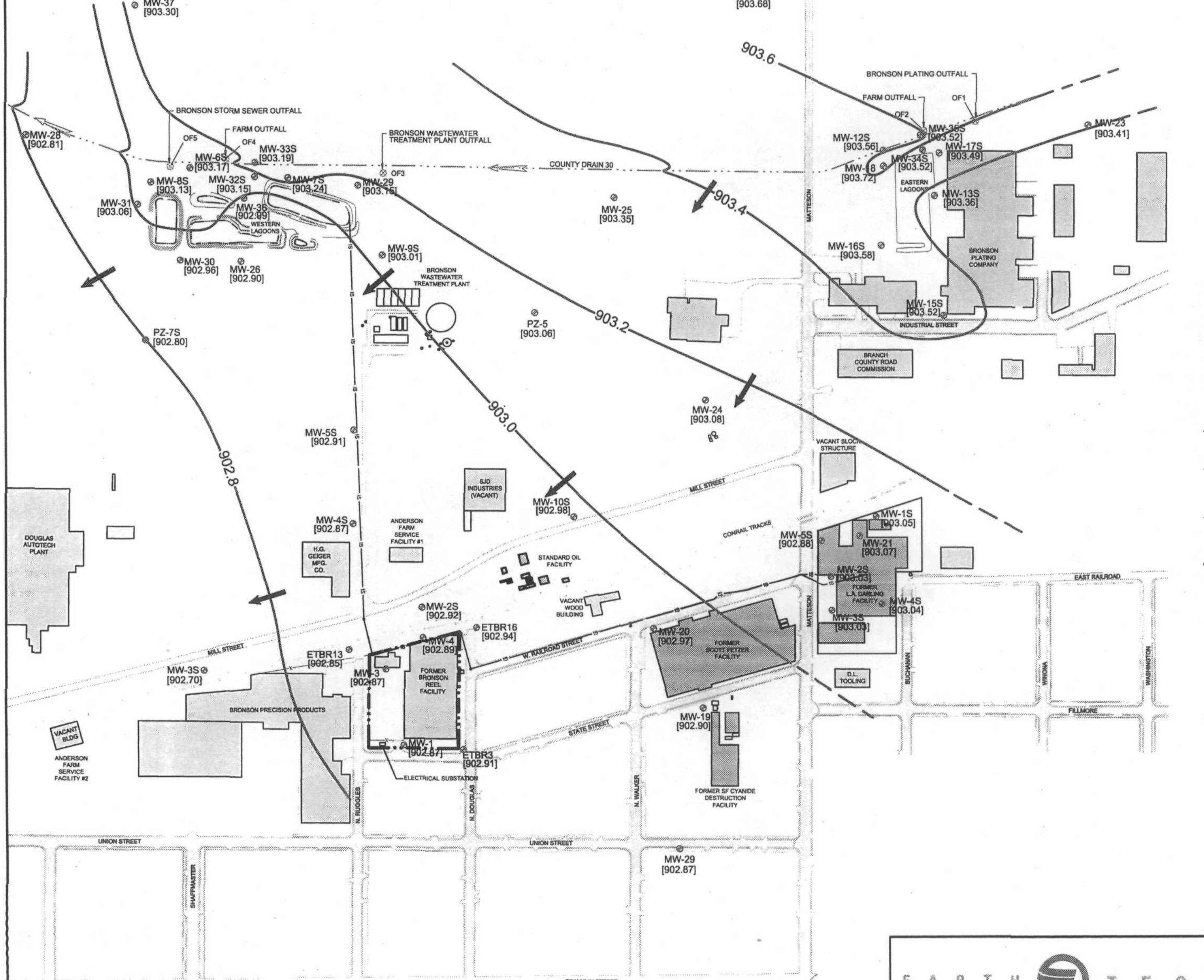


FIGURE 3-2
NBIA GROUNDWATER SURFACE CONTOUR MAP
APRIL 22, 1992

FORMER BRONSON REEL FACILITY - OU1
BRONSON, MICHIGAN



LEGEND

- FENCE
- RAILROAD
- PROPERTY LINE
- EXISTING BUILDING
- DEMOLISHED BUILDING
- WESTERN INDUSTRIAL SEWER MANHOLE LOCATION
- MW-10S — NBIA MONITORING WELL LOCATION
- [903.08] — GROUNDWATER ELEVATION IN FEET MSL
- LOCATION OF WESTERN INDUSTRIAL SEWER BASED ON EARTH TECH SURVEY
- LOCATION OF WESTERN INDUSTRIAL SEWER
- OF 2 — *SEWER OUTFALL LOCATION*
- COUNTY DRAIN 30
- NORMAL SURFACE WATER FLOW DIRECTION
- GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION

NOTES:

1. THE GROUNDWATER ELEVATION CONTOURS WERE ESTIMATED FROM GROUNDWATER ELEVATIONS CALCULATED USING THE MEASURED DEPTH TO WATER AND OCTOBER 2002 TOP-OF-CASING SURVEY DATA (OCTOBER 2003 SURVEY DATA FOR MW-17S, MW-23, AND MW-25).
2. WELLS MW-1S (902.78') AND MW-39 (902.51') ARE BEYOND THE MAP BOUNDARIES BUT WERE USED TO ESTIMATE GROUNDWATER ELEVATION CONTOURS.
3. MW-S5 AT LA DARLING WAS NOT USED TO ESTIMATE CONTOURS.

SOURCE OF BASEMAP: KEBS, INC., JOB NUMBER 02-G-68080, REVISED JANUARY 2003, PROVIDED BY ARCADIS.

0 150 300 600

SCALE IN FEET

EARTH TECH

A Tyco Infrastructure Services Company

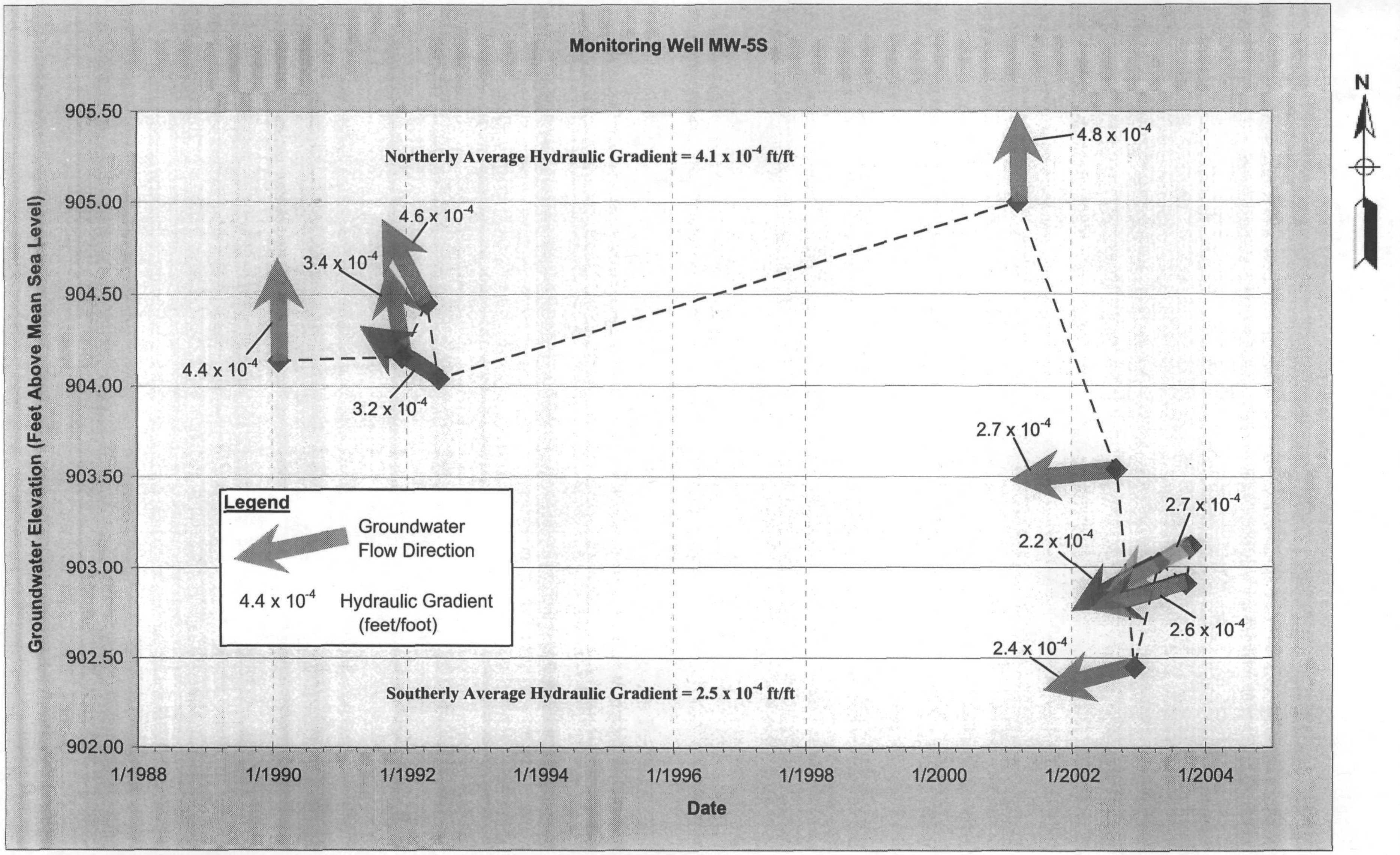
FIGURE 3-3

NBIA GROUNDWATER SURFACE CONTOUR MAP

SEPTEMBER 16, 2003

FORMER BRONSON REEL FACILITY - OU1

BRONSON, MICHIGAN



Notes: 1. All groundwater elevations were calculated using October 2002 Survey Data.

2. The groundwater flow direction at MW-5S was determined from hand-drawn contours of the groundwater elevations for each date. All wells surrounding MW-5S with measured groundwater elevations were used to interpret the groundwater flow direction for that date.

EARTH TECH

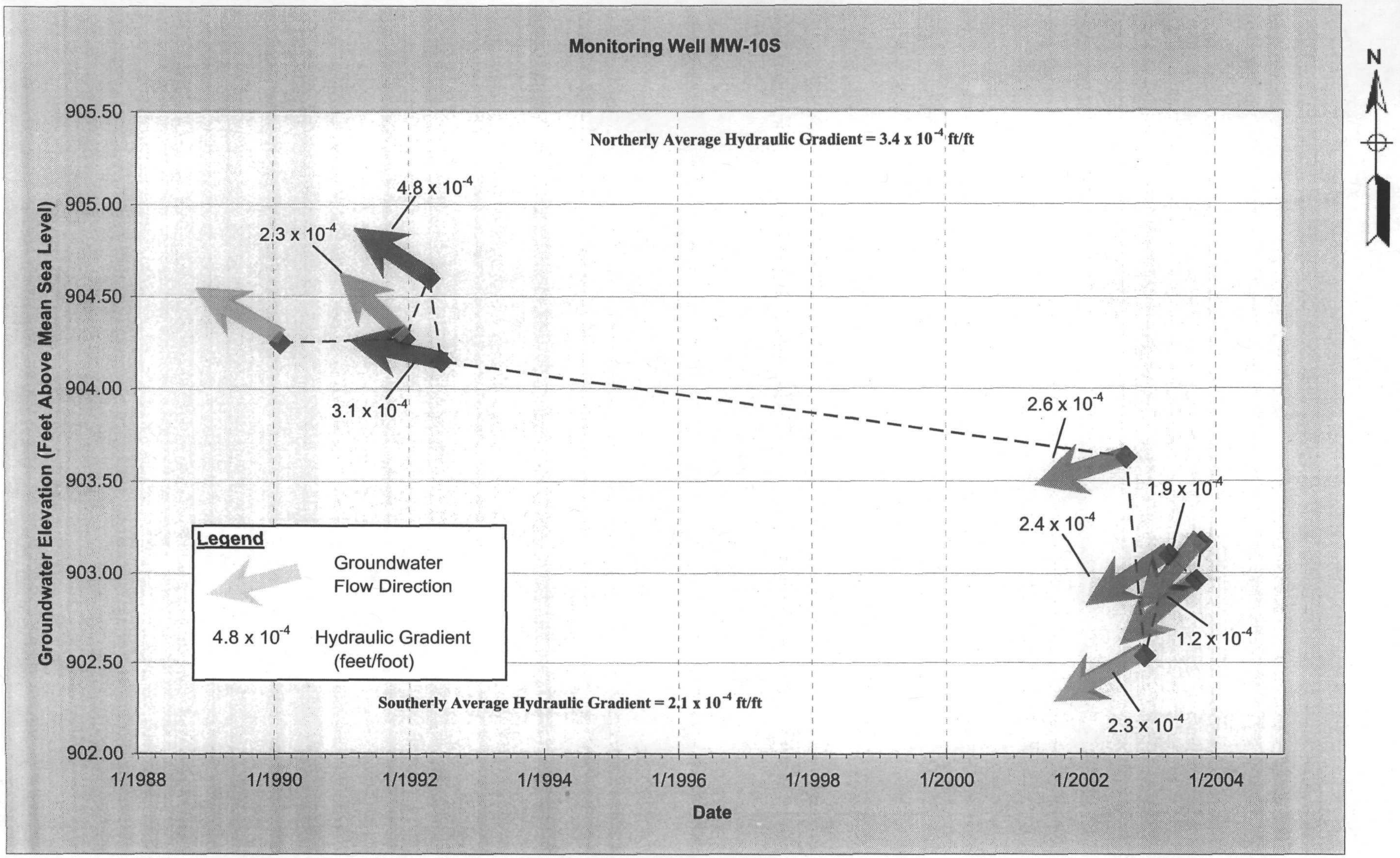
A Tyco Infrastructure Services Company

FIGURE 3-4

GROUNDWATER FLOW DIRECTION IN RELATION TO WATER TABLE ELEVATIONS AT MW-5S

NORTH BRONSON INDUSTRIAL AREA

BRONSON, MICHIGAN



Notes: 1. All groundwater elevations were calculated using October 2002 Survey Data.

2. Hydraulic Gradient for 2/1990 was not included because a lack of water level data around MW-10S precluded the calculation of an accurate gradient.

3. The groundwater flow direction at MW-10S was determined from hand-drawn contours of the groundwater elevations for each date. All wells surrounding MW-10S with measured groundwater elevations were used to interpret the groundwater flow direction for that date.

EARTH TECH

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FIGURE 3-5

GROUNDWATER FLOW DIRECTION IN RELATION TO WATER TABLE ELEVATIONS AT MW-10S

NORTH BRONSON INDUSTRIAL AREA

BRONSON, MICHIGAN